

In this Issue  
AIR ROLE ADVANCED  
IN NEW ARMY

APRIL  
1942

# AVIATION

The Oldest American Aeronautical Magazine

McGraw-Hill Publishing Company, Inc.

Price 50¢ per copy



## Wildcats in Action

"...in a recent engagement between Japanese land-based aircraft and Grumman Wildcat carrier-based fighters, a total of ten Japanese fighters and three bombers were destroyed without a single loss of our own planes." —Secretary Knox. These Wildcats, like all other Grumman F4F's in Navy service, are powered by Pratt & Whitney Twin Wasps.



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faithfully indicates the  
"ups and downs" of flight

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DIVISION OF BENDIX AVIATION CORPORATION • BENDIX, NEW JERSEY



## ★ ★ IN THIS ISSUE ★ ★ ★ ★

**FINANCIAL DEVELOPMENTS** listed large in the aviation press during the last month. In a discussion of the general financial situation for the last editorial (page 58) points out that a number of aviation manufacturers are setting aside reserves against the expenses of these inevitable transitions from war to peace time operations. We believe that this practice of generally followed will simplify the process of readjustments of the industry after the war.

**AVIATION'S WAR COMMUNIQUE** No. 8 continues the running commentary on power in this war. Biggest developments since the publication of the last issue of the U.S. Army ground air power equipment system with the ground forces, and the striking of the Navy command which placed a flying admiral at the head of operations.

### GOOD NEIGHBORS

The way in which nations are continuing harmonious relations is described in a story by Leonard E. Read, who

graphed and discussed a meeting plane, many of which have not been presented previously to the public. Aviation shows three full pages of German aircraft (pages 87, 88, and 89).

### AIR TO PRODUCTION

The Manufacturing Section of this issue leads off with a complete and up-to-date article by Dr. D. B. Freedrich of the Rohr & Haas Co. on current problems of Plastics insulation (page 60). Illustrations and sketches help to color ingenuity the text. It should prove of invaluable assistance to design engineers and production men in achieving greater economy in insulation of insulating products.

**Designing Propellers to Meet Performance Requirements** (page 70), by Harold H. Warden of Corman-Wright's Propeller Division, describes those factors that are considered in coordinating propeller design with airplane design. The complete sequence of machining operations in the production of vibration-free, the Lockheed P-38 Interceptor, is shown in a series of six articles by W. G. Ward (page 74).

The first of a series of articles by Walter C. Clayton, chief engineer of the Detroit Technical Institute, on design charts for tubular members begins on page 80. Design engineers will welcome these short cuts for determining wall thicknesses of tubes subjected to bending to yield a desired amount of safety. Later articles will deal with such topics as stress and torsion.

G. R. Tamm, of the General Electric Company's Industrial Transformer Division, presents a practical method for salvaging part of the enormous energy generated in hitting aircraft impacts (page 88).

Part I of an article describing the method by which the strength of riveted and bolted joints in calculating lagons on page 91. This article, the last prepared by Wayne A. McGowan, senior

radiotronics point out that the strength of our lagons will be reinforced by policies to the north after the war when it is noted we'll depend on numerous rather than political considerations (page 93).

Continuing our series of articles designed to assist management of aviation production plants, there begins on page 56 an article which demonstrates the importance of improved health, nutrition, recreation, facilities, motivation, and motivation in any program designed to build morale.

Adding to its collection of photo-

Harold H. Warden



graphs and illustrations of young planes,



Frank T. Courtney

young aircraft of Consolidated Aircraft.

Four good references even are being turned out in volume for the military services and commercial operations is described in a story on the Research Aviation School (page 134).

J. A. Tamm of Northwest Airlines describes the equipment used by Northwest in its construction of transports during their layovers on the map between Europe and Asia (page 165).

## Coming

Frank T. Courtney, whose colorful history as a pilot and engineer is well known to all aviation people, has prepared a provocative article on remote propeller drives and reaches some conclusions which may surprise experienced aircraft engine power engineers to many flying engineers.

The accompanying photograph, originally from Courtney's early life, shows him as he looked in 1927 when then a captain in Britain's Flying Corps.

The promised article on aluminum substitution is also scheduled for May along with the usual complement of production, design, research and engineering articles of immediate importance.



**18,400 spot welds in  
7½ HOURS  
on aluminum alloys**

Typical installation of a General Electric inductor-welding machine. G-E rectifier control which has enabled the Glens Falls Machine Company to make in 7½ hours 18,400 spot welds in 1½ hours.

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POINTS THE WAY TO WINGS FOR ALL AMERICA



## AIR *Superiority* *is not a matter* *of numbers alone.*



• Above is AWA Wet Type Universal ECCENTRIC Valve Seat Grinder in use in aircraft cylinder. At right is AWA wet type ECCENTRIC in use in radial cylinder.

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# HALL ECCENTRIC SEAT GRINDERS

AVIATION April 1942



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**FAFNIR**  
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for  
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THESE *Cupforged* TOOLS WILL DO THE JOB

Designed with regular offsets of  $7\frac{1}{2}^\circ$ ,  $10^\circ$  and  $15^\circ$ , these Aero Tool Cupforged Offset Box Sets provide accessibility for setting rivets in out-of-the-way locations—where they're tough to get to.

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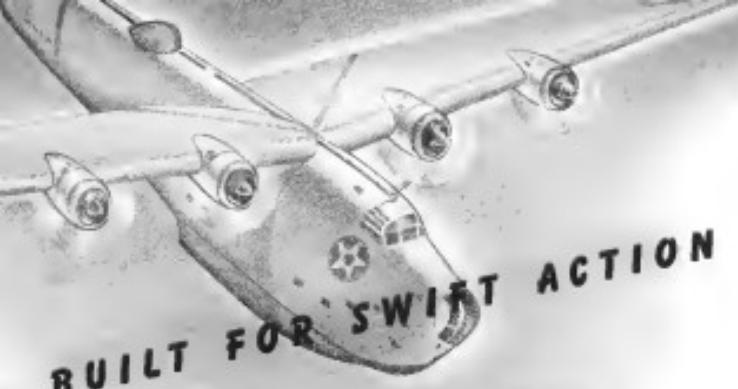
al accuracy and surface perfection.

It's the constant attention to detail—the "make it better or don't make it" policy that accounts for the wide acceptance of Aero Tool production tools by leading aircraft companies—every tool from Aero Tool is designed to do its job better, faster, easier, longer.

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Every component part working with precision accuracy...that's what the challenger is up against when American aircraft goes into action. Speed, accuracy, staying qualities, firing power! \* And back of all this are the men at the controls...the pilot, the observer, the gunner, the radio operator...each in his special task a skilled expert...each alert to the need for swift action. \* From specifications that are approved and adopted by aviation engineers and production officials, GF craftsmen build light weight, strength and comfort into seating that answers every requirement for keen, wide awake action.

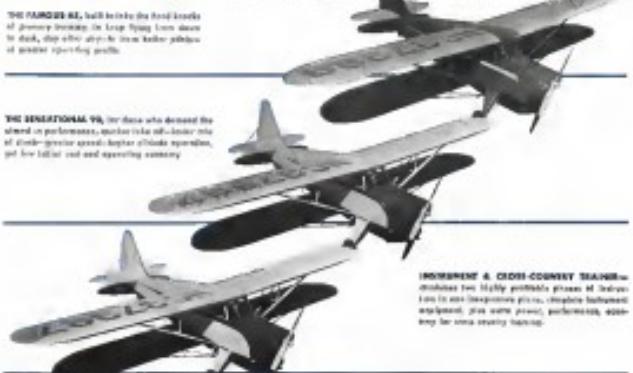
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YOUNGSTOWN - OHIO

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THE SENIORATION 70, for those who demand the most in performance, makes take-off-climb ratio of climb-greater speeds-longer climbs operation, yet low initial cost and operating economy.



INSTRUMENT & CROSS-COUNTRY TRAINER—  
includes two highly portable planes M-11s.  
Capable of cross-country flights, complete instrument  
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New Cadet Plants serve 42 states  
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There's a bigger job for compressed air in your plant today and tomorrow. Are you using compressed air power to the full? Do your present compressors have the capacity—the efficiency that modern production demands? Here are two Gardner Denver Compressors that can step up your air capacity at a lower cost per cubic foot of air delivered.



- 2—FAMOUS FOR UNUSUALLY LOW HORSEPOWER REQUIREMENTS—  
GARDNER DENVER "KX" SINGLE-STAGE INDUSTRIAL AIR COMPRESSORS

- Long years of service assisted by rugged, efficient construction.
- Extra efficiency due to liberal and unrestricted valve and port areas.
- "Air-Cooled" Disc-Plate valves actually become lighter with use.
- Built-in capacities from 25 to 1272 cubic feet displacement per minute.



- 3—FAMOUS FOR CONTINUOUS RELIABILITY PERFORMANCE—THE  
GARDNER DENVER "W" TWO-STAGE INDUSTRIAL AIR COMPRESSOR

- High overall efficiency assured by unrestricted air passages and large valve areas.
- A cooler running compressor assured by extra large water jacket areas.
- "Air-Cooled" Disc-Plate valves decrease noise and wear...actually eliminate valve breakage.
- Capacities range from 168 to 1854 cubic feet displacement per minute.

Write for complete information on the many performances of Gardner-Denver "KX" and "W" Industrial Air Compressors. Gardner-Denver Company, Quincy, Illinois.



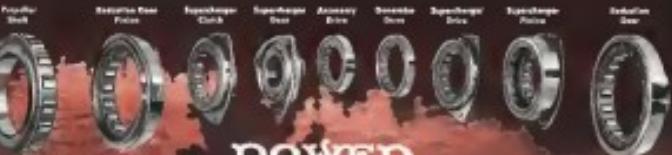
**GARDNER-DENVER** Since 1859

AVIATION April 1942



## REPLYING TO YOURS OF DECEMBER 7TH....

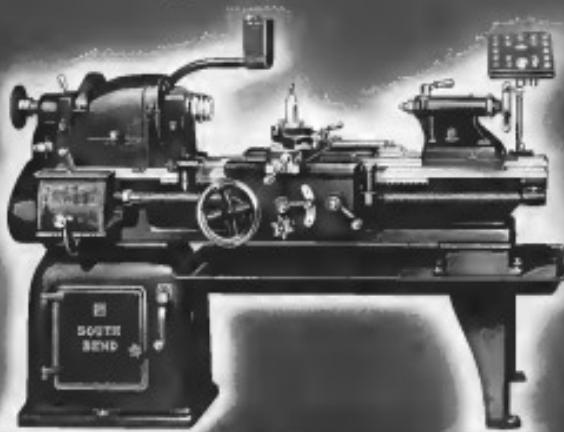
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A mighty armada of warplanes, many of the most  
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**V**ERSATILITY which permits quick change-over from one job to another, with little down-time or loss of time, is a real speed-up factor in taking a new job. Such versatility—the reduction of set-up time to a minimum—enables you to get into production quickly. It is one of the advantages in selecting South Bend Lathes for urgent defense contract work calling for early deliveries.

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AVIATION, April, 1941

# Not to stop... but to DESTROY INVADERS



The U.S. Army Air Forces are not satisfied with using only the superior speed of fighter planes to intercept enemy俯冲 fighters. The invader must be destroyed. A product of that belief is the Bell Airacobra. "Cannon on Wings". We see barding the Airacobras with a 37 mm. anti-tank cannon which fires explosive shells

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*Making Aviation History*

AVIATION April, 1940



BUILD LIGHTER...  
ASSEMBLE *Faster...*

WITH THE *Fastest* THING IN FASTENINGS!

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They are lighter in weight and are applied about twice as fast. In many aircraft attachments, they have saved as much as 80% in weight of fastenings. SPEED NUTS also effect dramatic reductions in assembly costs and provide a double spring lock that resists the most severe vibrations.

SPEED CLIP 5938 is our newest time saver for attaching junction box covers. It can be attached by hand and fits all junction boxes from .025 to .064 in metal thickness. Write for Bulletin 153 and we will rush complete information and samples.

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Accelerates Assembly

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Lowers Net Costs

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**VANGUARD**  
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Wherever the lighting is thickest, the *Vulve Vanguard* and the *Vulve Vengeance* win the respect of pilots—desire the respect of the enemy. Completely radio-equipaged by *Reindeer*, these defenders of democracy serve with the British and U. S. forces in practically every sector of the West. It's scratchin' time.

know that Bendix Radio Equipment has "won its spurs" under fire; even more gratifying to report that Bendix Radar facilities are being stepped up at an unprecedented rate, to meet the demands of our war effort. BENDIX RADAR, Div. of Bendix Aviation Corporation, Baltimore, Md. U. S. A. Cable Address: BENDRAD.



WINGEANCE  
Don Barker

**BENDIX**  
**RADIO**

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*You* TOO, MUST  
TAKE THE OFFENSIVE  
TO WIN SUCCESS!

Aviation has JOBS for thousands,  
but CAREERS only for trained men!

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the first time with a different type of film, or during a "spurts" process. One must like the off-white and white the proper setting in to get the most enjoyment.

positions—it materials prepared to a certain stage in advance. Only the specific items with long usage periods are assumed to be relatively nonproductive . . . and ONLY the end customers are to be concerned through the responsibility that user before sales. Resources' productive units such as process, distribution, etc.

The exercises who have made up the TBRB reader must have had the confidence and incentive to continue on as a life work and to pass on their knowledge for its proper training. They know that the value of such work is largely determined by the ability and enthusiasm of those who carry on the task. And they know that Carnegie-Wright Institute literature graduate work — and its many years here — has especially helped in all the scholarly writing of our times.

Situated in the very center and a very important part of Southern California's great research industry with an assets over one billion dollars in unfilled orders, Convair-Wright Tex has come to be recognized as the nation's leading w-

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ARMED TRAINER



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THE TRAINING PLANE  
ENGINE OF TODAY  
THE PRIVATE PLANE  
ENGINE OF TOMORROW

WILLIAMSPORT, PA.

LYCOMING DIVISION THE AVIATION CORPORATION

AVIATION, April, 1944

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keep ahead to keep 'em flying!

A Typical Aerol Strut

America's aviation industry still must achieve an almost undreamed of pace of production. As builders of Aerol struts for aircraft landing gear, it is our grave responsibility to meet the tremendous demands of an all-out war without delay! These demands will be met. But in addition to expanded personnel and plant facilities, another vital force has been enlisted to achieve this end—the subcontractor. Throughout the nation, subcontractors are working to produce over 250 different parts for Aerol landing gear struts. This is the American way. Because of the willing assistance of these subcontractors, America can rest assured that Aerol strut production will keep ahead to keep 'em flying!

THE CLEVELAND PNEUMATIC TOOL CO.  
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## FORGET YOUR OLD ASSUMPTIONS

### IMAGINEERING

### IMAGINEERING

### IMAGINEERING

### IMAGINEERING

THE JOB  
IS  
BEING  
DONE

**IN THESE DAYS** an advertisement is no place either for boasting or sermonizing about production. Every man knows how well he is doing the job that is before him. Deeds, not words are the measure.

**BUT WORDS CAN ROCKON** beyond the realms of immediate duty.

**IMAGINEERING** is such a word. We coined it to make the needs of the future a reality, here and now. It is a way of describing what a man can do about the day when...

**HOW DO YOU DO IT?** You let your imagination soar and then engineer it down to earth. You think about the things you used to make, and decide that if you don't find out some way to make them necessarily better you may never be asked by your customers to make them again.

**YOU FORGET YOUR OLD ASSUMPTIONS.** For instance, you may be one who used to assume that aluminum was too expensive. Even if you were right then (and you may not have been) the price trend of aluminum knocks those assumptions into a cocked hat.

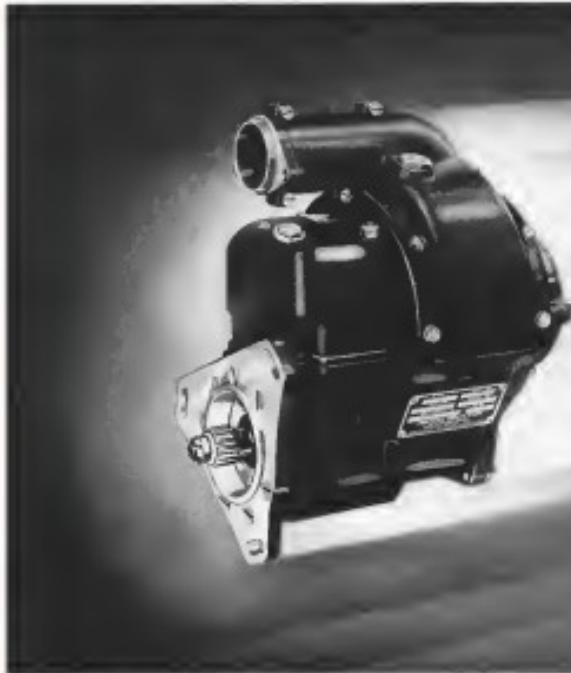
**WERE YOU ONE** who used to assume that structures behaved exactly the way the theory said? Have you looked into the new corners the mammoth testing machine in the Aluminum Research Laboratory has found for that one?

**DID YOUR OLD PRODUCT GROW** like Topsy? More than one designer is悲哀ing with this point of view. My product was in a groove. I couldn't get it out, because I didn't dare get too far away from last year's model. Now's my chance to start from scratch, and let tradition be hanged.

**WHAT IS THE KIND OF THINKING** that will make jobs in the future. It is the kind we can help with; help with ideas and with know-how. Will you write us?

Aluminum Company of America, 2183 Gulf Building, Pittsburgh, Pennsylvania.

## ALCOA ALUMINUM



For engines requiring magneto ignition, American Bosch has always been the hallmark of quality. The war in the air gives fresh significance to this reputation, for today American Bosch Aviation Magnetos are standard on some of America's mightiest warplanes.

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# AMERICAN BOSCH MAGNETO



## How PERMITE helps *Save POUNDS* to add MILES!

Officer Pilots, U. S. Army Air Corps

To help save the vital need for eliminating useless weight in the construction of bombs, planes, ships and other fighting equipment, Aluminum Industries plants are turning out PERMITE Aluminum and Magnesium Alloy Castings in tremendous volume.

Just as the light weight and other special advantages of Permite Castings have long contributed to the efficiency of commercial and industrial equipment, so they now contribute to the flying range, speed, and economy of our combat equipment.

Permit's pioneering experience, plus modern production and laboratory facilities, enable us to supply efficiently improved Sherman and Marauder tanks; aircraft parts, made to standards established by the Technical Specification Board, U. S. Army Air Corps and Navy Aircraft Department.

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**PERMITE** ALUMINUM AND MAGNESIUM ALLOY CASTINGS

AVIATION April 1942



NEW BENDIX UNIVERSAL  
PRESSURE REGULATOR  
[UNLOADING VALVE]

*Superior performance results from  
new poppet-type pilot valve design*

Bendix Aviation, Ltd., presents this outstanding Hydraulic Pressure Regulator—with seven important advantages over all pressure regulators—advantages achieved through the use of the exclusive plastic poppet pilot valve:

1. Absolutely leak proof. "Creep" toward the cut-in or cut-out pressure completely eliminated.
2. Guaranteed to operate at -45°F.
3. No appreciable shift in operating pressure at a high system Head off or at various flow conditions.
4. One integral system relief valve, eliminating extra cost and extra plumbing.
5. No liquid fits—faster production and easier maintenance as all parts are 100% interchangeable in the field.
6. Relief valve assembly is removable from airplane without disturbing insulation or plumbing.
7. One universal model for both 1,000 psi and 1,500 psi systems.

**BENDIX**  *North Hollywood*  
SUBSIDIARY OF BENDIX AVIATION CORPORATION

DISCONNECT COUPLINGS  POWER BRAKE VALVES  CHECK VALVES  PRESSURE REGULATORS   
HAND PUMPS  ACTUATING CYLINDERS  HYDRAULIC ELECTRIC SWITCHES  RESTRICTOR VALVES   
SEQUENCE VALVES  HYDRAULIC SELECTOR VALVES  TUBE CLAMPS  CUSTOM BUILT RADIO 

# WHERE WILL YOU SERVE?

If you are fitted and needed as a soldier or sailor, cabin attendant. But if you have a skill that makes you more valuable for technical service, then give it where it's needed. If you do not have it, go and get it. State mottoes and ambassadors will do as much to win the war as mother goes and sells, and you can play an important part by skillful handling of any of them.



## SPARTAN Training Will Equip You for An Important Position!



*(Editorial) Drafting and Design Room at Spartan Engineering School*



*(Editorial) Shop in the Maintenance Engineering Department*

### SPARTAN'S New 4-Day-Week Schedule Shortens Training Period

Recruit-a-circumstance that trained men be supplied in all branches of aviation or the aerospace industry. Spartan's unique approach to day work schedules and training has proved successful to complete courses approximately 25% faster than the usual high-quality training programs. Spartan's new 4-day-week schedule accommodates pre-term graduate personnel earlier. Mail coupon for complete facts.

# SPARTAN

SCHOOL OF AERONAUTICS

DIVISION OF SPARTAN AIRCRAFT COMPANY

**What About Your Future?**—With peace comes, and it will come, aviation is going to be a greater luxury than ever before. SPARTAN'S superior training and unequalled facilities can equip you for a prosperous lifetime career. Now is the time to act.

Spartan School of Aeronautics—Captain Maxwell W. Bellair, Director  
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Please send me a copy of your catalog and let me know how I can qualify for admission.

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| <input type="checkbox"/> Air Transport Pilot      | <input type="checkbox"/> Army Ground Mechanics        |
| <input type="checkbox"/> Airline Pilot            | <input type="checkbox"/> Army Heavy Mechanics         |
| <input type="checkbox"/> Air Transport Mechanic   | <input type="checkbox"/> Army Radar Mechanics         |
| <input type="checkbox"/> Airframe Repair          | <input type="checkbox"/> Army Electronics             |
| <input type="checkbox"/> Aircraft Engineering     | <input type="checkbox"/> Army Electronics             |
| <input type="checkbox"/> Aircraft Maintenance     | <input type="checkbox"/> Army Electronics             |
| <input type="checkbox"/> Aircraft Metalworking    | <input type="checkbox"/> Industrial Electronics       |
| <input type="checkbox"/> Aircraft Sheet Metal     | <input type="checkbox"/> Industrial Electronics       |
| <input type="checkbox"/> Engine Rebuild Mechanics | <input type="checkbox"/> Motor Instrument Technicians |

## With Our Eyes to the FUTURE...



## We Give Our Complete Facilities to the Emergency of Today!



Over 500 women employees of the Spartan Instrument Division are now employed. These employees are graduates of the Spartan School of Aeronautics Technical Division. Women are now being assigned in all areas of the Spartan School. Through Spartan's production there are constantly increased opportunities.

Dedicate to duty's tradition with Spartans. For more than a decade this company has gained and maintained a reputation for doing one job and doing it well...producing the finest in aircraft.

Today...in defense of liberty...this tradition is being upheld and carried on in the manufacture of important aviation materials for the U. S. Government.

Tomorrow...after the battle is won...this same tradition of quality and dependability will be upheld and carried on in the new Spartan airplane of the future. Already Spartan is measuring the extent of its opportunity to be of national service after its defense responsibilities are discharged. Our eyes are toward the future. We are planning ahead to the time when a new Spartan airplane of spectacular merit will be available for a peace-loving,民主化的 America. Watch SPARTAN...a guide for top-ranking aircraft...yesterday, today and tomorrow!

**THE SPARTAN SCHOOL OF AERONAUTICS**, a division of the Spartan Aircraft Company, also plays an important part in today's national emergency. From this school, composed of the outstanding aviation school in the United States, some experts turned directly without retraining to the industry at every type of job. Thus does the Spartan factory have available an unlimited source of carefully trained and experienced employees.

## SPARTAN AIRCRAFT CO.

Contractor to the U. S. Army and the U. S. Navy

TULSA, OKLAHOMA



Flying Fine Aircraft Since 1927

For many years the SPARTAN AIRCRAFT has been known the world over as a choice example of sound aviation engineering. This all-metal, low-wing, cabin monoplane has won the admiration of the flying public throughout the world. It is the ideal plane for record speed, accuracy, climb and maneuverability. You may find interest in the new aircraft being planned.

*Taft-Peirce Announces...*



## THIS NEW BACK SPOT FACER

THIS MACHINE, already specified by leading aircraft motor manufacturers, was designed for counterboring or back-facing holes through which a hole has been drilled, but which, because of obstructions, cannot be counterbored or faced as a drill press, without complicated tooling.

The work is mounted on a 28" square extension table, over the front of which is a hole which allows the shank

of an inverted counterbore to project through the table. The arm containing the outer spindle, driven through lever gears by a 1/2 h.p. motor, is located in the base.

The counterbalanced spindle is provided with fast and slow hand feeds. The machine is available with or without clutch for disengaging the power from the spindle. Write today for bulletin containing complete specifications.

THE TAFT-PEIRCE MANUFACTURING CO.



Rhode Island

AVIATION, April 1942



Where Inspection Ends . . .  
*Performance Begins*

• Piston Ring performance depends directly on design and then—faithful production.

Here at Muskegon the faithfulness of the finished product is made certain by rigid inspection of both materials and workmanship.

The most modern technical apparatus in the hands of experienced engineers assure Muskegon users of high and consistent performance.

Let us consult with you on problems relating to Piston Rings.

MUSKEGON PISTON RING CO.

Muskegon, Michigan

PLANTS AT MUSKEGON AND SPARTA



**MUSKEGON**  
Piston Rings

# The Birdmen's Perch



Mike will sit in his plenty short French Bobs will never take up a place below without a thorough inspection. Mike will tell her that you won't otherwise you're next in Pennsylvania. Get you top 100.

**Holiday Air Williams**, 210 "Tuxedo West," Gulf Aviation Products, Massillon, Gulf Bldg., Pittsburgh, Pa.

## TUNNELBOMBER DIVE.

Dive for.

If that dive doesn't make a lesson, no lesson that even I think is. That one night back in 1946 I went out to the field right after practice flying. As the sun set I had only about 12 minutes left. I was flying over the east end of the field. I saw green, watched her up a while and landed for the second time in my life. I took off and with the full length of the runway I descended the wind, gained the altitude and dove straight down.

After a short time I saw it. I had around just enough fuel to get me home. I turned off and I could spend what the course took time completely. I had to land, run back and get home.

I was well over the field but I guess my pilot instinct told me to the lowest and when I did it I hit the ground. I got out and using only rubber cement I managed to make a pretty landing. As soon as I got ground I took off again, made a couple of little turns and went home. I had to land again. I checked out the front seat there, and turned back on the engine so the car stuck where it did. I had to turn the engine off and back onto what looked like concrete and when I had replaced it I lied back on the seat and closed my eyes. I had to make a little adjustment before I could sleep. The field didn't really have to come along, but the time they were up off on it.

It was back to the air again. This writer has been flying since he was 16. He doesn't like anything but present day aircraft. Yours truly,

Bruce Baker,  
Massillon, Ohio

## SHOVIN' OFF THE BATTLE JUNK.

It pays to be discriminating as plane designers have proven time and again. Look at the latest Martin bombardier. Two prop drives that hauls more are the only outer surfaces in the plane which do not directly contribute to lift off.

These designers apparently figure a ship to carry more to switch bases to the top corner. And now we have the beginning to build over as probable performance. They began to expand. By the time the ship is rolled out for tests,



they've gone off somewhere to draw up a plan to sell themselves THREE times over!

Our comical men here at Gulf are pretty much like that. They never seem to know exactly what to do or to start off. They want Gulf products to be better tomorrow than any other add. Even



things they check out the latest models, then they would go to the engineers. So they designed the special Model P-51 which does just that! It goes MILES over the ordinary and sluggish amateur type of Gulfstream and you, too, can have the same kind of pleasure. That's why so many of the new planes we designed with anything but Gulfstream!

## THIS MONTH'S BRAIN TWISTER:

An airfield has a field one mile square. One side is bounded by a line of trees. The other three sides are flat fields. A field engineer has to come along and the time they were up off on it.

It was back to the air again. This

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## New BALL-TYPE SWAGED FITTINGS

### FOR AMERICAN CABLE *Korodless* CONTROLS

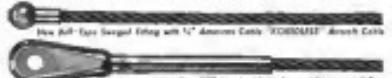
When American Cable engineers originated Perfected Aircraft Cable and Strand they made it possible for you to have controls with characteristics that are vital today. That is because American Cable's perforating free wires and strands of internal stress. Therefore, cable and strand is easier to handle, quicker to install, and resists bending longer.

The same organization originated swaged fittings to reduce weight, save cable, and give you fittings that hold beyond the rated strength of cable or strand with which they are used.

They developed efficient stops, anchor ropes and mooring pendents. They organized to supply complete assemblies to your specifications—existing Army and Navy requirements.

Now they offer you another great advance—American Cable control assemblies that use the new **BULOC BALL-TYPE SWAGED FITTINGS**.

These new fittings also hold beyond the rated strength of strand or cable. Yet they are only a fraction of the size and weight of other fittings of equal strength—in line with modern design and a tremendous advantage for work in close quarters.



Be sure to write for the new booklet, THE NEW BULOC TYPE SWAGED FITTINGS FOR AIRPLANE CONTROLS.

**AMERICAN CABLE DIVISION • WILKES-BARRE, PENNSYLVANIA**

Aircraft Department • 210 Park Avenue, New York  
6-312 General Motors Building, Detroit

2475 Pico Street, Los Angeles

• • • **AMERICAN CHAIN & CABLE COMPANY, Inc.** • • •  
BRIDGEPORT • CONNECTICUT



## ARTILLERY *of the Air*



### Cannon Nosed 'Cobras Take the Offensive Aloft

The artillery officer's dream of a flying gun-platform finds practical expression in the high-performance Bell Airacobra. With specially designed Curtiss Electric Hollow Hub Propeller accommodating a 20 or 37 mm. cannon, the Airacobras can strike the enemy on the ground or in the air with lightning speed and effect.

**CURTIS-WRIGHT CORPORATION • PROPELLER DIVISION • CARMEL, NEW JERSEY**

**CURTIS** *Electric*  
PROPELLERS



## Answers to 17 questions most frequently asked about FLUORESCENT LIGHTING EQUIPMENT

Never before have we been asked so many questions by production men, and these facts would seem to explain their growing interest in fluorescent lighting equipment.

1. The major improvements which have been made in fluorescent lighting equipment is general.
2. The greater cost of fluorescent equipment is due to the higher purchase price.
3. The extreme importance of higher illumination to the war effort.

If you can't find the answer to the most frequent questions in this report to production-men

Is there any one kind of Industrial Lighting? Yes, continuous-duty fluorescent equipment is the standard for industry by lighting authorities.

Is there any one kind of fluorescent system? We think MILLER's 500 FOOT CANDLER and 100 FOOT CANDLER and MILLER TROFFERS are incomparably superior to any other equipment on the market today. The MILLER products are the original manufacturers of fluorescent systems.

When were the first MILLER installations made? In 1938 R. Fluorescent Systems became a unit of General Electric.

How many installations have made? Over 500,000 units of MILLER Fluorescent Lighting Systems are in use.

In what kind of plants? In breweries, restaurants, night clubs, office buildings, and the like, in all types of office supply stores.

What kind of deliveries are you making? Deliveries are now very limited, but will expand if building schedules are in order. And we are still unable to make a delivery without a MILLER engineer on the job.

What about price? We like yourself are dependent on increased demand. We

are experiencing 200 percent with the war profits.

Are you listed in terms of fluorescent?

200 MILLER Engineers are listed in the "Industrial Engineers" section of the Yellow Pages for every manufacturer and industrial needs.

What is the significance of the names 500 FOOT CANDLER and 100 FOOT CANDLER?

MILLER FLUORESCENT SYSTEMS, Inc., Model F lamp, is designed to provide a minimum of three candlepower of illumination, and the 100 FOOT CANDLER, using 100 foot candle power, is designed to provide 100 foot candle when suspended and spaced at regular intervals in the average plant.

Are MILLER lighting fixtures certified by Underwriters Laboratories? No, they are not.

"Safety first" is not possible because there are more than a "hundred" ways for them to provide a safe lighting system, wireways, conduits, etc., and each of these ways, including possible sources of flame, is unique in its own way.

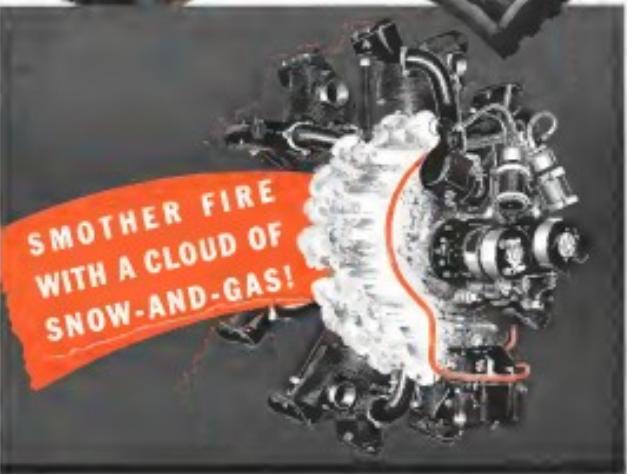
Are MILLER ROOF CANDLES and 100 FOOT CANDLER suitable for use in roof-mounted ducting areas, and similar locations?

Yes, but MILLER TROFFERS, continuous fluorescent fixtures, are better suited for such areas, especially where there is a possibility of fire.

How do we go about getting our place lit up with a MILLER Continuous Fluorescent Lighting System? Write the Miller Company, 1000 South Main Street, Des Moines, Iowa, or phone your nearest representative.

Any "traps" to be observed from Page 2 Safety system? No. They carry MILLER guarantees, and have been

IF YOUR ENGINE SHOWS THIS...JUST PULL A HANDLE...



**YOU** mean that your engine's on fire? You need to put it out? It's a job. A job of LUX equipment designed to extinguish and gas smother the flames. Nothing could be simpler.

It's quick! No extinguishing agent is required. Kills fire faster

than LUX carbon dioxide. LUX chokes out fire in 3 to 4 seconds!

And it's Clean-cut! No fire killer is as completely harmless to an aircraft as LUX. Clean, dry, LUX gas disappears faster than water when its extinguishing job is done.

These are Built-in LUX Systems for both multi-engine and single-engine planes . . . for "valves" as well as radial engines. LUX flame

detectors, mounted with built-in LUX Systems, only be used on the aircraft when a completely automatic fire lighting-off.

Why choose fire in the air, or on the ground, when protection against it is so easy, sure?

Write us for the free booklet - "White Magic."



**Walter Kidde & Company, Inc., 422 West St., Bloomfield, N. J.**



# ADVANCED TRAINERS

*Powered by*



# JACOBS *Engines*

ARE TRAINING THE COMBAT PILOTS  
FOR THE UNITED NATIONS



JACOBS AIRCRAFT ENGINE CO.

FOTTSSTOWN, PENNSYLVANIA, U.S.A. . . CABLES: JAECC

## THE RED CROSS

needs the financial aid of every American.



Contribute today through your Local Chapter.  
Be as generous as your circumstances permit.

THIS SPACE CONTRIBUTED BY THE D.G. CORPORATION

# FEDERAL Aircraft BEARINGS



FEDERAL SPECIALIZES IN THE PRODUCTION OF QUALITY BALL BEARINGS • ITS POLICY IS TO MAKE THE FINEST BALL BEARINGS REGARDLESS OF ANY OTHER CONSIDERATION • THE FEDERAL ORGANIZATION IS DEDICATED TO THIS ONE PURPOSE—THIS ONE IDEAL.

THE FEDERAL BEARINGS CO., INC.  
*Makers of Fine Ball Bearings*  
PHILADELPHIA, Pa. T.

Bureau Office: 2000 First Floor • Cleveland Office: 402 Bowditch Building  
Chicago: 4910 N. Paulina Ave. • Los Angeles: 1100 Wilshire Blvd.



AVIATION April, 1942



You bet you do!

And they are in mass production...  
every required relay, contactor and circuit  
breaker built to specifications by men who  
know aircraft needs from ground to ceiling.

What about your requirements for electrical contactors, relays and circuit breakers? In the Cutler-Hammer line you will find the electrical equipment you need, the most popular accepted and service proven designs, built to specifications, accepted by both Army and Navy, and already in mass production. No delay for development work. That's been done... by C-H engineers long familiar with aviation needs and known the world over for their leadership in electrical control equipment. Samples can be sent you immediately. Write or wire today. CUTLER-HAMMER, Inc., 1413 St. Paul Avenue, Milwaukee, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto.

Structures that count  
for warplane reliability. These are specific designs  
designed to withstand extreme weather conditions.  
Components receive extensive tests before every unit  
will appear in any production item. Every circuit breaker  
tested for a period of months. Right materials  
selected for maximum strength. Cutler-Hammer C-H vacuum  
relays will withstand 100% vibration. Cutler-Hammer C-H vacuum  
potentiometers operate below

## Cutler-Hammer makes a complete line of:

✓ Contactors for remote control of:  
Battery disconnects • Wing fairing release • Fuel pump motors  
Starting motors • Altitude control motors • Hydraulic pump motors  
Dishwasher relays • Rubber control motors • Turbine speed control  
Oil filter switches • Brake control motors • Gearbox temperature control  
Windshield wiper motors • Clutch control motors • Gearbox starting motors

✓ Relays for ground, interlocking, control circuits, resistive,  
Circuit breakers and switches for all purposes.

Not just one or two items or types but a complete line from 25 to  
200 amperes, single pole, single throw, single pole, double throw,  
double pole, single throw; double pole, double throw.





CAN AMERICA BUILD  
*185,000 Planes*  
IN TWO YEARS?

The President has called for 60,000 planes this year—123,000 next year—a total of 185,000 planes within two years. That's a lot of airplanes—and they'll take a lot of aircraft salvaging—but the planes will be built. Americans won't let America down.

And we at Steel and Tubes Division are working full-out efforts to supply more and more Republic ELECTRUNITE Aircraft Tubing to the Aviation Industry. ELECTRUNITE—made by the same proved process of electric resistance welding used in producing millions of feet of precision, mechanical and structural tubing—meets specification standards of the U. S. Army Air Corps, Bureau of Aeronautics, U. S. Navy Department and the Civil Aeronautics Administration.

Every length undergoes a special non-destructive electric test to assure absolute freedom from any possible hidden defect.

Republic ELECTRUNITE Aircraft Tubing is made in sizes from  $\frac{3}{8}$ " O.D. up to and including  $1\frac{1}{2}$ " O.D.—and in gauges from .035" up to and including .063"—16 S.A.E. X-6130 steel.

Republic ELECTRUNITE Tubing also is made of ENDUROR® Stainless Steel is standard analysis and is made from  $\frac{3}{8}$ " O.D. to  $3\frac{1}{2}$ " O.D.—in gauges from .035" to 11 gauge—and is conformance with Government Specifications.

To complete detailed information write—

**STEEL AND TUBES DIVISION**

**REPUBLIC STEEL CORPORATION**  
**CLEVELAND, OHIO**

Bureau Manufacturing Division • Midland Precision Division  
Cleveland Sheet Division • Lubert Division • Toledo Prod. Company

May 15, 1942

*Republic*

**ELECTRUNITE**

**ELECTRIC RESISTANCE WELDED TUBING**

Air Cooled Tubes • Condenser and Heat Exchanger Tubes



**THIS BAKER TRUCK  
broke records in 1923!**

*Still going strong in  
1942!!*



Polymer Co., Inc.

Industrial Truck Division  
Polymer Co., Inc.

General

The man has got here long service record.  
The first time he handled this job, still  
affectionately, and you can see his differences in  
the appearance. The place already has  
experience received. The way out of this job is  
now very simple.

Here is something to talk about. For  
first time the customer was issued a car of  
accident in battle, so place of station. This is a  
recomendation.

Please reply today,  
Baker Industrial Truck Division  
2322 West 25th Street • • • CLEVELAND, OHIO

design as well as on steady construction. Baker Trucks are designed to do their job, and are made to take plenty of abuse without showing short age. Let us demonstrate how they can serve you to your plant.

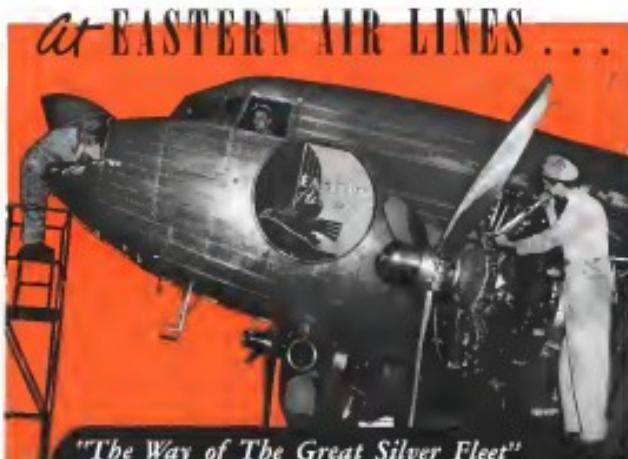
**BAKER INDUSTRIAL TRUCK DIVISION** of The Baker Building Company  
2322 WEST 25TH STREET • • • CLEVELAND, OHIO

**Baker INDUSTRIAL TRUCKS**



GRUMMAN AIRCRAFT ENGINEERING CORPORATION • EASTHARVEY • LONG ISLAND • NEW YORK

AVIATION, April, 1942



*"The Way of The Great Silver Fleet"  
is the way of good maintenance, with*

"We send them on their way, serviced with Snap-on!" says Mr. H. G. Leslie, Maintenance Superintendent of Eastern Air Lines. "As we sleep and overheat ships, the dependability and durability of Snap-on tools are important factors in preserving ever-higher standards of maintenance."

And thus another of America's finest Air Lines maintains its high quality of Snap-on tools... to performance as dependable as the planes it flies.

OVER 2000  
KNUDSEN & TOWN  
TOOLS FROM  
MIDGET WRENCHES  
TO HIGH DUTY  
UNS



AVIATION, April, 1942

# ***Snap-on Tools***

able in aviation as in the automotive and industrial fields where "Snap-on" has been a name for tool leadership for 22 years.

Snap-on's 8,000 tools and direct-to-you service are conveniently near you from 35 factory branches in every state and province throughout the United States and Canada. Write for catalog and full information.



SNAP-ON TOOLS CORPORATION, 2020-21 21st Avenue, Kenosha, Wisconsin

# DEFENDERS

OF LIFE, LIBERTY, AND THE  
PURSUIT OF HAPPINESS

Preserved as by the Constitution of the United States, is our heritage of freedom, but preserved among the guarantee who carries this glorious privilege is the greatest honor also comes the courage of our Air Forces... Physically the crown of our nationhood — naturally the best of all time, but no man who values either courage or daring, sees the Air Force name have first-class equipment — planes, parts, munitions — and has them delivered to their needs! It is a significant tribute to America's skill and reputation that we are now going "all out" producing the several racing commissions awarded as far as the diesel Faxes, & a. a. a.

The *America's Defender*, designated by contractors as "brave of the year" is similar to its sister ship, the O-38, now "on operation" with the Army Air Corps. *a. a. a.*  
Aviation Aircraft Corporation, Middlebury, Ohio, U.S.A.



## The America's Victory Award

The Aviation Aircraft Corporation pledges its entire resources, management and expert technical staff, to help the brave men and women who are privileged to fly for their country. *a. a. a.* This means I trust, that we will be employing every man that deserves better products or services than racing opponents; it is not difficult for us "all out" pledge to do the job in the America's spirit of time.



# HERONCA



Where the job is important  
—files must be right



Men machine working up an airframe during assembly in an engine during inspection during aircraft job. Courtesy United Air Lines.



To carry assurance of victory, America's war effort must be efficient as well as hope. In airplane construction and maintenance especially, not a single detail must be left to chance or to estimation than can put "good enough." Only "the best job that can be done" gets the required inspection's seal.

Such high standards of craftsmanship demand the right tool. As well as the right file for the job. In a file it makes out that is important in dimension and size for the length of the file, shape or part which it is used, for the amount of metal to be removed and the finish or precision to be attained.

In addition, it must be thoroughly dependable—if uniformly fine stock, uniform cut, uniform hardness—so that the handholds will render exactly the same performance as the first.

There is no better file-selecting guide than the recommendations of the largest manufacturer of quality files in the world—under the Middleton guarantee of *Twelve perfect files on every dozen*.

These Nicholson special purpose files especially used in aircraft work are unique and highly distinctive of the *Nicholson*. Available in these special sizes for *Fuselage*, *Wings*, *Propellers*, *Engines*, *Tools*, *Plastics* and for *Decomposing*, *Rust*, *Paint* and *Litter* etc., will gladly be mailed on request. Write soon desired. For your file needs, contact your mail-order houses.

**NICHOLSON FILE CO. • PROVIDENCE, R. I., U. S. A.**  
(Also Canadian Plant, Port Hope, Ont.)

**NICHOLSON FILES**  
FOR EVERY PURPOSE



**UNITED  
AIR LINES**

 \* COAST-TO-COAST \*

**1941  
SAFETY HONORS  
GO TO  
DOUGLAS EQUIPPED AIRLINES**

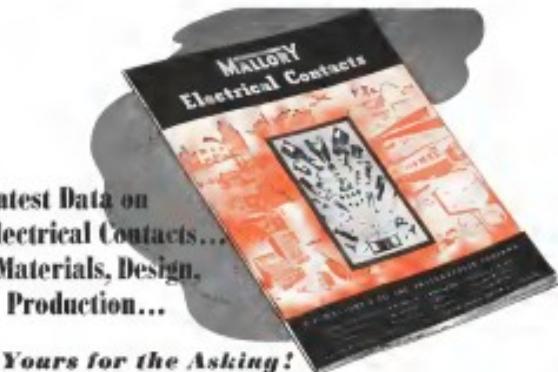
Ten of the airlines cited by the National Safety Council for operating without a fatality throughout 1941 were Douglas equipped. Top honors went to United Air Lines and Braniff Airways.

Thus in war as in peace the nation can "depend on DOUGLAS."

**DOUGLAS AGAIN *first* IN AIRLINE SAFETY**

Following are the Douglas-equipped airlines of the Americas: American Airlines Inc.; Braniff Airways Inc.; Canadian Central Airways Inc.; Canadian Air Transport; Chicago & Southern Air Lines Inc.; Delta Air Corp.; Eastern Air Lines Inc.; Hawaiian Airlines, Ltd. (now Island Airways Ltd.); Northwest Airlines Inc.; Pan American Airlines System; Pan American-Gulf Airways; Pan American-Caribbean Airlines Corp.; TWA, Inc.; Western Air Lines Inc.

AIRPORTS April 1942



## Latest Data on Electrical Contacts... Materials, Design, Production...

***Yours for the Asking!***

Electrical contacts control the surging power of millions of horsepower...in land, in the sea, and in the air. Mallory has been the nation's headquarters for contacts and contact assemblies for more than 20 years...while Mallory engineers have developed improved contact materials, new contact designs and high-speed production techniques for turning out better electrical contacts faster, at lower cost.

The new Mallory Contact Catalog offers you more than 50 pages of useful data...a textual digest of many man-years of electrical and metallurgical research. Here are a few features of this informative, illustrated book:

- 1. How To Select Contacts—electrical, mechanical and economic factors.
- 2. How To Design Contacts—both standard and special types.
- 3. Mallory Contact Materials—chemical and physical properties and typical applications of tungsten, molybdenum, zinc and copper silver; alloy of silver, platinum, palladium and gold (Electron Series); powdered metal alloys, copper, silver and other metals (Elastite Series); Mallory bronze; Mallory Tally and Ovotite Metal; and Mallory E.C.C. Metal.

### 4. Availability Table for Contact Materials

### 5. Mallory Individually Fused Type Contacts—a new development

### 6. Mallory Complete Contact Assemblies—to speed your production

### 7. Mallory Alloys for Current-Carrying Springs

### 8. How Mallory Develops and Produces Contacts

### 9. Contact Application Index—to make it easy for you to refer to products you manufacture or consider manufacturing

Write us today on your company's stationery for your copy of this new complete Mallory Contact Catalog.

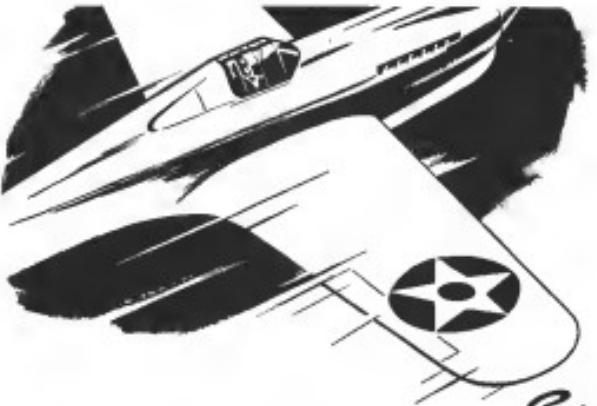
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**MALLORY**

**ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES**  
**NON FERROUS ALLOYS, POWDERED METAL ALLOYS**

AVIATION April 1942





## We've hitched our production to a Star

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AVIATION, April 1943



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To join the Flying Fortresses\* already in action on world-wide fronts, large numbers of these long-range, four-engine Boming bombers are now rolling off American production lines.

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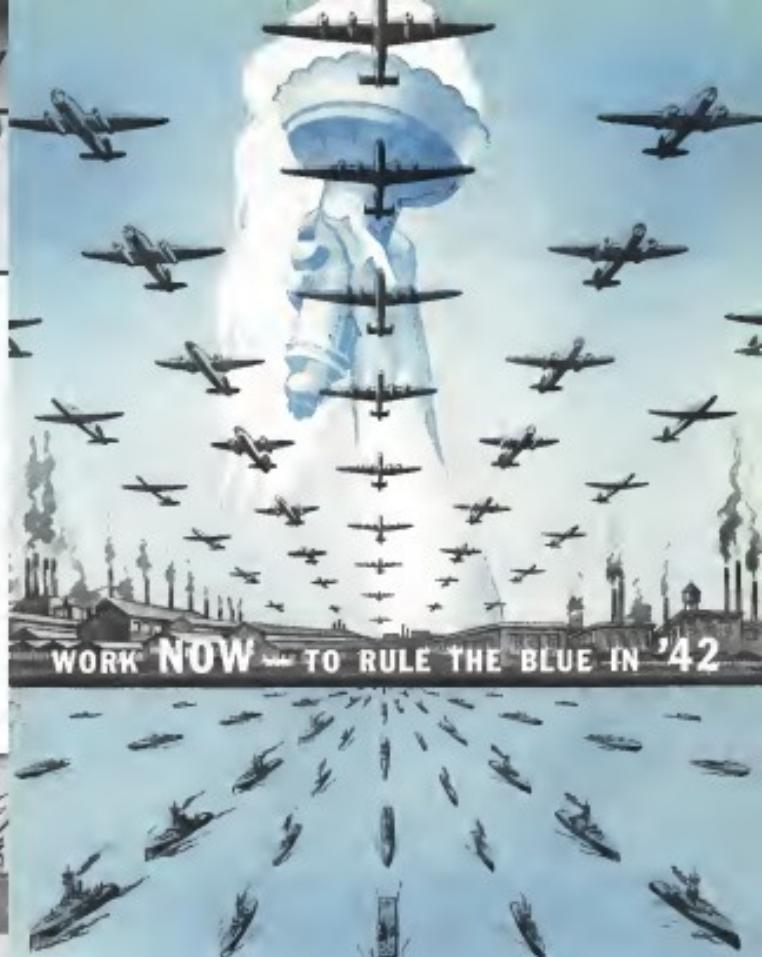
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SUGGESTED BY R. D. DEWEES  
HOWARD AIRCRAFT CORP., CHICAGO, ILL. U. S. A.

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We have just introduced a new precision checking tool to the VARD Roll Thread Snap Gage. This Vard gage offers definite improvements over existing gages. It not only checks the pitch and depth of the thread to be inspected but also checks the lead. Furthermore the new Vard snap gage will check threads right up flush against a working shoulder.

This is a beautifully made production inspection tool with Go and No Go thread rolls. Its rolls are ground from special tool steels and are fitted with excess pins to compensate for wear. The gage fits in the hand and is easy to use.

VARD Roll Thread Snap Gages are made in a full range of sizes in tolerances from 0 to several thousandths. They can be sold to holders of high preference ratings.

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SUCCESSOR TO VARD MECHANICAL LABORATORY

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...the Part...  
and the Product**



## TYPE TEST: Full-load, full-speed landing impacts ...200 of them

Scores of precise inspections during and after manufacture of Bendix Pneumatic Shock Struts maintain the close dimensional tolerances and high metallurgical standards demanded by the service these members must render.

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SWIVELABLE AND STEERABLE TAIL-KNUCKLES • PILOT SEATS

## Money, Materials and Profits

WHEN CITIZEN JONES radios in his comfortable chair at night and reads that 60 billion dollars more have been appropriated by Congress for planes and guns and tanks, he skips the unpleasant resort of the latest enemy victory and never doubts that the war is in our bag. He also skips the news item lesson on page 24 that Premier Togo has just told his subjects that "War is not won with money." But this happens to be an instance in which Togo's bloody dictators are quite right. There is far too much talk about money resulting from Washington these days and it is building up a false sense of security among American people. Neither money nor victory will help us win this war.

When the final score is chalked up it will be a problem in simple addition. The side having mobilized the greatest amount of efficiently used manpower of labor and the largest quantity of materials will be the winner. At the moment we are short on both of these but the most severe shortage is in materials.

The conversion of workers from other industries and even from agricultural pursuits to aircraft industry has been done and is being done with greater ease than was thought possible. The industry has recruited two armies of workers and placed them along many newly-created production lines. But all of this is of no avail if these workers are required to make bricks without mortar.

Aircraft production has been easily delayed by not so lightly as "the anticipation of shortages." An production can increase, the whole manufacturing mechanism rapidly becomes over-loaded. Failure of an insignificant subcontractor to deliver on schedule, interruption in the jet distribution flow of any single part or material, can play havoc with tool availability and upset the efforts of tens of thousands of workers.

After a production line has been set up it is a comparatively simple matter to keep it going, as long as the main factor is given what he wants when he wants it. We can teach the high objectives in aircraft production out by the President only if the materials are forthcoming as scheduled.

Further evidence of the unimportance of money in the present war effort is found in the annual reports of several aircraft manufacturers, which are discussed elsewhere in this issue. Several of these manufacturers have gone in for a new kind of pioneering which should set an enviable example for other industries. They have performed something whose unprecedented first in voluntarily returning funds to the government. United Aircraft has passed 1941 operating expenses back to the Navy Department to the tune of \$10,000,000. North American has cut profit on accepted contracts by 2 percent below base, and has reported a net profit on Army-Navy orders of 1.3 percent in 1941.

A number of unusual contrivances are being made reserves for the expenses of their inevitable transition from war to peacetime operation. It is only reasonable to assume that the cost of retooling when the war will be comparable to the instant change-over from a peace to a war basis. This policy is in full accord with the principles of the American system of individual enterprise and will do much to smooth over the rough spots in the industrial transformation to come. This in turn will simplify the process of readjustment of industrial consumption and will therefore relieve the government of some part of that responsibility after the war.

These highly considerable ratios should be studied and followed where possible by other manufacturers in aircraft and other industries. They indicate sound management as well as economy and will have the incidental value of making life hard for any congressmen who are trying to waste political capital of alleged profiteering in industry.

Yester E. Neale

**Army command stripped for action, with Air Force attaining full status equivalent to combined ground forces. Billencourt raid starts off belated Allied aerial offensive.**

PRESIDENT ROOSEVELT and his general staff made one of the supreme tactical moves in this world war when they stripped the Army down to bones. With the devastating order the Commander in Chief reduced it to its three foundations: Air Force, Ground Forces, and Supply. Most of the trained military hardware and trained crews of armored generators were swept away with the stroke of a pen.

The unarmamented commands of Infantry, Artillery, Armor, Field, are abolished. It's better to do these with some muscle and spirit than with a pen. They are their own separate entities. Command is General Air Force. They are all overseen by a single Command, like men on a chess board, with the single purpose of carrying out a mission. The Infantry, Artillery, Cavalry, etc., will exist and it is proper to refer to them as such, but not as branches of the Army.

#### AIR FORCE IS ON ITS OWN

Air Force, Ground Forces, and Service or Supply appear to be equal in rank. They are autonomous, except that they are under a single command, the General Staff, headed by the President. These three divisions, like the various arm-

ments of the Ground Force are ganged together for one purpose in preparing successful wars.

You can think of the new Army as still another nation, divided into parts. One part is the fighting men—the ground troops and the air men. The other part is the supply arm, which designs, procures, delivers, and maintains the supplies and weapons for the fighting men.

The logic of this is obvious. Compare it with a job in an operating room. The surgeon is the man at the table, with a staff of expert helpers to look for what others have written down. The new Army is the surgeon, the surgeon with the supplies at odd times about him that work well, and what changes should be made, but that is all. There is no overlap of authority.

Look at the effects of the reorganization on the Air Force. Since World War No. 1, the air arm of the Army has been presenting its own plans. A few months ago the Air Corps was reorganized as the Army Air Force, with two divisions, the Combat Command, and the Air Corps. The Air Corps had charge of training, carrying, persons, intelligence, material. Thus, the Chief of the Air Force was responsible



These are the British paratroopers who paved the way for the devastating RAF attack on the Rennet works near Paris by sailing in the destruction of a German radio detector post in Montreuil France.



The formidable Iron grip exercised by this paratrooper traps pilot of the fire power of the British paratrooper batteries.

for the Air Corps, procurement, and everything else.

#### ENRICHED COMMAND IN AIR FORCE

The new set-up abolishes the Air Corps. As this was originally a several years venture that procurement of appliances, including research and development, such as the close at Wright Field, plus maintenance, was being transferred to the Service of Supply, where the logic of the scheme seemed to indicate a logicality. This is related directly compensation—a broadening that increases the horizons acts both the able, the high-ranking officers being freed from the particular bonds of the corps to be scattered about from the party.

Admiral Ernest J. King, now Chief of Operations, established this command of the 1st, 2nd, 3rd, and 4th Air Forces. You will recall that this command was the GHQ Air Force until the recent formation of the Army Air Force. Now, the Combat Command is one, and the various units report to, and receive their orders directly from, the Chief of the Air Force. A number of other commands: Training, Flying, etc., also report directly to the Chief of the Air Force. Thus, after growing up with the airman as a fighting unit, General Arnold becomes one of the three commanders of the United States Army (see page 10 of this issue).

Recognition does not mean that we have an independent air force which since some suggestions and others have been calling for. It is possible, even probable in the sense of time, that as the versatility of air power is developed, the air arm may take precedence over all others. But it becomes increasingly apparent that we are not to have a separate air power in this war. To my mind, would be preposterous. As near as can be determined, there is now no separate air command in the world except RAF. That independence of air force is not complete. And even if it were, RAF has several follow-ups shot up against its bellows, moreover.

While the Army Air Force, along with the Army, can sweep in comes drag, once again indicated it was high time for such a major re-arrangement. American men were still on an airfield in the Far East, for it looks as if the Japs are out of job.

#### NAVY FOLLOW SUIT

Following close on the heels of the Army changes, a reorganized and streamlined Navy Command was announced.

Again, emphasis was placed on the air arm by the appointment of Admiral Ernest J. King as Chief of Operations. During the 1930's Admiral King had put along every command post in connection with naval aviation. He is one of the few high ranking officers qualifying as a naval aviator.

There is a close parallel between the new Navy staff organization and the Army set up. Admiral King's administrative staff will consist of Rear Admiral F. J. Horan, in charge of planning, organization, and procurement; and Rear Admiral Russell M. Waes, supervising details of operations at sea. This set-up eliminates the overlapping and friction of numerous that heretofore existed in the Navy High Command.

#### ADS STILL HOLD TEMPORARY HIGH IN AIR

Navy air power figured hardly in the emergence of the East. But now, when low pressure of war, indications increase that Japanese interests in the air is the largely to lack of experience. They controlled the air in the Philippines, Singapore, and in Java, because practically nobody else was there. This keeps consciousness for the Sons of Bataan will figure off. Low morale among the Sons of Bataan and other Allied troops show up on the other side. Low morale however, even more aspiration now than ever, since they will have to fight from Australia and Alaska. They can also attack from Russia, of the Japanese might with that country.

#### EUROPEAN AIR WAR—ALMOST THRU

Observers had been wondering all winter what was happening to the protracted British air assault on Germany and occupied Europe. Now, it turns out that the long winter nights they were causing were accompanied by awful weather. The last winter pretty much was with the Russians and Germans also. Their warfare losses have been far less than those predicted, and it doesn't take a reference to (Continued on page 109)



Left to right: The commanders of the newly reorganized Army: Lt. Gen. Henry H. Arnold, Air Force; Lt. Gen. Lesley J. McNair, Ground Forces; Maj. Gen. Brooke, E. Barracell, Service of Supply, and the new Head of Operations, Admiral Ernest J. King, a flying officer. Associated and tape of decades was swept away with the reorganization.



High over the Andes, a Pan American-Brasil Airways DC-3 transport heads south for Santiago, Chile. It is by means of fast air communication for covering the vast distances between the U. S. and the countries of South America that we are expanding our trade with Latin America.



Leonard E. Read

### Air transportation is playing the leading role in establishing vital trade relations and a good neighbor policy with Latin American Republics.

**T**HE PRESENT WAR has created a bond between the United States and our South American neighbors that is indisputably strong—at least for the present. The strength of this bond after the war depends principally upon war, rather than political considerations. That, in turn, depends upon "trading for trade" which means a willingness to trade through mutual understanding of needs, and availability of communications and transport. And this is where our international airlines will play the major role in continuing hemisphere relations.

The fact that this is a war of economy—where the availability of materials and of personnel savings is important—is causing us to establish "trade facilities" at a speed and to a degree that would have taken decades to accomplish in peacetime with the war restrictions of the world at one moment. Commercial air transport is fulfilling this emergency task, and expanded air transport on an economic, not a war basis will perpetuate it.

Air transport has already played a large part in the emerging of the countries with South America. It has made possible the rapid exchange of written information and samples of products which business requires in liquidating their plans. Of even more importance

is the service of air transport in making it possible for business, political and social leaders of both countries to visit each other and establish intimate personal and business relationships.

To enable us to do our part in presenting such personal and business ties, the Los Angeles Chamber of Commerce

has long been active in arranging air tours of South America by business and civic groups. We have also established business offices in Mexico City, Rio de Janeiro, and Santiago. Air transport makes it possible to keep in close touch with these offices and to which trade trips back to Los Angeles, with



One of the Pan American Isingravia stations is an open modernized marine airport.

AVIATION, April, 1942

## Aviation

# Makes Good Neighbors

By LEONARD E. READ,  
General Manager, Los Angeles Chamber of Commerce



The hub of Lima, Peru, showing the wide avenues and parks.

manufacturers samples or premium products sent here by express plane in time to reach customers which could never be handled by any other medium of transportation.

My trip around South America, prior to my entry into the war, helped to give me a better grasp of the tremendous problems which have been precipitated by the war. The whole complex fabric of Latin American commerce had already

(Turn to page 234)

A Pan Am-Motor Flying over Santiago, Chile.

The DC-2 "Senda Latina" of PAA at the Lima Airport in Peru.



Modern apartment houses in Copacabana, a suburb of Rio de Janeiro.



# Healthy Workers Produce More

By HARVEY M. HALL



In the battle for production, improvement in the health of workers not only reduces time lost from the plant, but builds morale and increased efficiency. Nutritious food, sanitary precautions, recreation and health education speed the work.

**N**O CIVIL or wartime England doubts that shortness of industrial workers is a grave problem. Efforts continue to plan an industrial nation which can meet every emergency created since the last war has been reduced to a comparatively small number. According to British authorities, today's shortness is due, chiefly, to illness and lack of morale.

A program aimed at protecting and improving the general health of employees here in England is believed, and only will reduce losses due to illness. Let also well known among us in America is the following case of high production, high health and improved health. As the all-out war program brings into high gear, measures to end fatigue become of great importance. The experience of England may serve as a guide. Last year the British Ministry of Information reported that a plant manager had increased by the whole average situation when he said that "working a seven-day week means

paying for eight days. Double pay for Saturday) and getting only six days' rest." Accordingly, the Ministry of Supply recommended a three-shift system and the government later authorized a fifteen-work week with one day's rest, preferably on Sunday. Already the Ford Motor Company has had to revise working schedules. Long working hours, officials announced, "were found to have不利 effects" on men producing aircraft engines. Their work accordingly has been restricted to 48 hours a week with Sunday work eliminated.

In addition to efficiently planned work schedules, a measure that can strengthen considerably both health and morale is the provision of proper food, served conveniently, sanitarily and attractively, at appropriate intervals. Everyone who has ever looked back from the table after a satisfying meal, and sighed "Now I feel good," knows how good may left morale.

The first largescale attempt to assure

(Turn to page 196)

**Left:** This, too, aids production. Key Davis, West Coast airplane worker, bows with one of the numerous Lockheed firms. Below: More than 5,000 Lockheed and Vega employees holding the "gravyard" shift packed the service lounge of Burbank, Calif., when Key Spur breakfasted his regular program from the aircraft plane.

# German Aircraft

Major裁減 new military models have been produced in Germany since the outbreak of war in September, 1939. Known types used by the Nazis are derivations of successful models of pre-war development.

There has been much surprise over the possibilities of air raids by Germany long range bombers, particularly the Heinkel 111. On paper this bomber has a theoretical maximum range of 7,000 mi. with a 1000-lb. bomb load. Consider-



## GERMAN AIRCRAFT



These day observation training and escort fighters have excellent low wing and maneuverability.

FIESLER Fi 156



DORNIER Do 215

Built as a transport and fighter, it has a 2,000 cubic-foot容积 (cubic feet) machine adaptable for aerial photography. It has four direct engines.

A fully enclosed and tapered high wing monoplane for easy conversion with minimal modification.

A twin-engine, all-metal, three-seat aircraft purpose monoplane distinguished by two tall booms. The speed is 225 mph.

A stabilized version of the Fw 200 Konigsberg transport. Its long range has made it effective in attacks on convoys.

A high performance single engine fighter, it is reported to have a wingspan of 30 ft. and a top speed of 400 mph.

Long range all-metal biplane carrier of sand and white type. Has a top speed of 305 mph.

An easy recognition in a series of the high wing type. Has no all-metal passenger fuselage.

Robust and maneuverable dive bomber. The speed of 242 mph makes it vulnerable to ground or anti-aircraft fire.

Latest version of the single engine fighter has rounded wing tips and a top speed of 380 mph.



FOCKE WULF Fw 200



HEINKEL He 111



JUNKERS Ju 88



HENSCHEL He 111



HENSCHEL He 111



MESSERSCHMITT Me 109



JUNKERS Ju 87



MESSERSCHMITT Me 109



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There's some value in scrapped steel but no value whatever in scrapped time. That's an elemental thought but a profitable one to remember if you are placing an order for steel today.

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Sheet, Tubing, and Threaded Rods.

## MANUFACTURING SECTION OF AVIATION



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MANY of the first Phosflor installations in military aircraft are still serving active service. Time and war and weather have made only minor knock on the transparency and dimensions of the original, unique of only academic interest.

## PRINCIPLES OF SUCCESSFUL INSTALLATIONS

"Flexoplex" is the registered trademark for the acrylic resin thermoplastic sheets and rods manufactured by the Johns & Haas Co. It has fully met and exceeded the following specifications:

*Portuguese has proved as dependable even under severe weather conditions—provided, however, that it has been properly installed.*

When proper consideration has not been given to the properties and limitations of the material, Plexiglas has occasionally cracked or crazed. Usually it has not failed so fast as other types of transparent plastics fed under more favorable conditions, but in such cases it has not given the long service although apparently given more or less of its

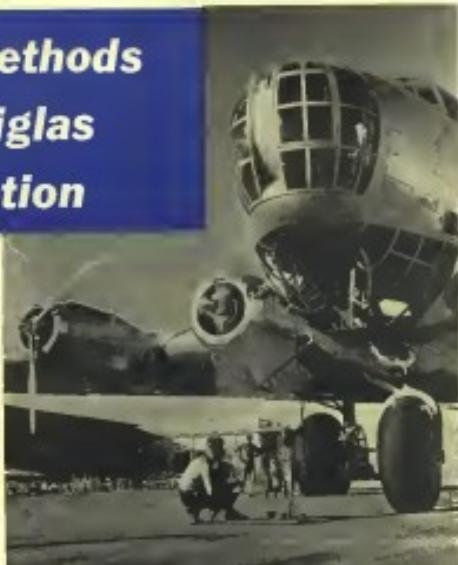
engineers have come to expect of it.

Since correct installation is so essential for satisfactory service, this article is aimed at that direction. It not only contains specific suggestions for mounting Memphis but outlines the considerations behind these designs. It does not pretend to exhaust the possibilities of the subject, but it does lay down basic principles for the guidance of the designer, engineer and producer concerned for whom it is written.

By Dr. D. S. FREDERICK  
John & Newell Co.

## **Correct Methods Of Plexiglas Installation**

Plexiglas has proved its permanence during years of service under severe conditions, but proper installation is essential to provide such satisfaction. Here are the basic principles to guide designers and engineers who are responsible for providing methods of installation.



stresses or fail. Frequently about 50% of every part is subjected to a heat treatment similar to annealing in glass or the casting of its manufacture. This process developed by the Kofax & Haas laboratories eliminates new tempered residual stresses set up during the casting of the sheet. In effect it preheats the material so that no further significant dimensional changes take place in spite of weathering and other service conditions.

Small food stores may be set up by buying or marketing Douglas. But there are no great savings unless a considerable area of material is involved. To a certain extent, process are also set up during the forming of a Douglas sheet into a curved section. If the material is even reasonably hot when formed,

however, these stresses are well distributed throughout the section. Creasing may occur in a deformed place when a solvent for Pectinase attacks the surface and releases some of these stresses unequally. This may happen, for example, when a cluster contains such a solvent

is used on a fissile ooidic dolomite.

severely stretched during drawing. Crazing reduces the transparency of a plastic, but, more important, it is a symptom of a severely high strain differential and a warning that the material has been seriously weakened. A crazed plastic should be replaced as soon as possible. It is not enough to remove the craze marks by light local heating or by other superficial methods. The condition which caused the crazing must be remedied if continued service is expected.

#### **CAUSES OF CRADLING**

To determine the stress differential at which cutting develops, strips of 0.025-in.  $\times$  0.25-in. steel were placed in a frame arranged as in Fig. 1. Various weights were hung at  $R$  of 10 in. to produce unit fiber stresses at  $R$  of approximately 300, 1,000, 2,000, and 4,000 lb per sq in. These stresses were calculated from the following formulas, based on a 24-in. beam value  $F = \frac{Wl^3}{48EI}$ , where  $l$  is the load at  $A$  in pounds,  $W$  as the width and  $T$  as the thickness of the strip in inches.

Two seeds were used, one was placed in a dark closet, the other was exposed to the weather from August to January.

The results, summarized in Table I, lead us to recommend a minimum shear of 100 to 1,000 lb per sq in. if extended outdoor service is expected of the Pheasant States, within which limit, Pheasant retains its original transparency and strength indefinitely; every effort should be made to keep stresses below the given maximum to insure long-life under the anticipated service conditions.

卷之三十一

The obvious way to avoid stress raisers on any part of the Plasticite is to distribute the total stress over as large an area as possible.

is an important factor.

Plants in an area subjected to continuous flooding are often inundated to a certain extent at least all along the length occupied by the channel. Naturally, the deeper the flooding the larger the area entering the total stream. Variations in the thickness of the floodwater (annually 12 percent) and in the width of the channel, preclude absolutely regular distributions of stress, but when reasonable care is taken to keep the changing action uniform all along the course, excess pressure of any one point can be avoided.

able to use a simple channel or clamp mounting. At high speeds, air flow impelled a large, thin section out of its channel and unless it is halted or reversed, will cause some other retarding device to bind. A high friction device may also require positive attachment.

#### **Table 1** Standardization Factors for Measures

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protect the Plexiglas from direct pressure. Similarly, it is also possible to use long shank bolts or shoulder rivets or cap nuts to make it impossible to bring the threaded members closer together than the thickness of the sheet plus a reasonable clearance for thickness variations and for rubber packing. Thus, a combination of these methods provides as far as possible to prevent penetration and ensure longer service for the Plexiglas.

#### FUNCTIONS OF SHEAR GASKETS

It should be pointed out that the rubber gaskets recommended as most Plexiglas installations do not effectively prevent development of high stress concentrations. Their principle function may then be:

1. To take the insulation water-proof.
2. To reduce vibration.

3. To help compensate for thickness variations in the Plexiglas and width variations in the channel.

They help to distribute stresses only in a minor extent and only when the stresses are relatively small. When stresses are large, their rubber spring rate is not able to transfer them from one bolt to another until area and to reverse these directions so that they act almost as shear against the insulation, pressure, and insulation. Fig. 4 shows what may happen if these members are too flexible to distribute the load over the Plexiglas between bolts.

#### CASE IN INSTALLATION

These precautions may be sufficient if an experienced machinist decides to install a Plexiglas section "good and tight." All too easily a man can screw a nut and bolt tight enough to develop more than 1,000 lb per sq in of pressure on the glass. On the other hand, a number of us might be driven to use a hammer, thereby setting up high and unequal stresses.

Machines should therefore be instructed to avoid using any methods of installing Plexiglas sections just as they should be warned against scarring its surface. It may also be possible to equip them with tension wrenches so that forces over a given limit cannot be applied by a nut or screw. If this is not practical, instead assembly area to tighten each screw in and out there is back off one full turn.

#### SAFE TO USE SPACERS

If the latter part of words, however, in design an installation which cannot put the Plexiglas under any great pressure.

One good solution is to provide tabs spaced so it around the bolt and thereby

be inflected with ease since they may contain solvents for Plexiglas. It is a simple matter to cover a small length of Plexiglas with the material for several days and then to measure it for swelling or cracking. This simple procedure may also be followed more completely and reduce fatigue.

#### EXPANSION AND CONTRACTION CLEARANCES

The coefficient of expansion of Plexiglas is 0.007 per degree F, which is higher than the coefficient of materials with which Plexiglas is apt to be mounted. This difference means that allowances must be made for the Plexiglas to expand or contract in relation to the expansion of the metal frame, or bending and dangerously high stresses will result.

With a single hollow channel mounting system, Plexiglas can expand and contract simply by slipping along the channel—unless, of course, the channel clamps the material too tightly at its point.

With medium-sized pieces, it is possible to bolt at only one end and to allow the expansion to be taken up by slippage at the other end. With larger pieces, it may be preferable to bolt at the center of the glass and to allow the expansion and contraction at each end. If the Plexiglas panel is free to expand at both ends, only half the total expansion clearance need be provided at each end.

Wherever the size of the section or design of the frame makes it necessary to drill holes through the plastic and bolt or rivet it to supporting members, the holes in the plastic must be oversized so as to allow some movement of the plastic relative to the metal frame. If the holes in the holes and/or the plastic are drilled at the same time, the plastic should be removed and the holes re-drilled to the larger size. These oversize holes must be made concentric to the ones in the frame so that the bolt or rivet does not bind at one edge causing crimping or failure in these holes.

In sections of hemispherical shape such as in an insulation or gasket section, the outer surface changes and causes the spherical surface to expand or contract in unsupported areas. These changes of contour have given no trouble with Plexiglas sections up to 40 in. in diameter, but it is reported that provision for radial change be made at the circumference, where the section is attached to the supporting frame. Drilling the holes in the supporting attachment at one possibility. Another internal design idea is creating a Plexiglas bearing ring at one end of the edge and feeding the elongated holes in this ring. The ring also gives rigidity

to the section which facilitates handling and reduces leverage in installation.

#### CALCULATING CLEARANCES

For example, a high altitude plane might encounter temperatures as low as -60 deg F., or as high as 140 deg F., in service. For a panel installed at 30 deg F., expansion and contraction clearance would therefore be calculated as follows:

Coefficient of expansion, (F°)	Thickness, in.	Expansion factor, $\frac{1}{2} \times 0.007$
-60 deg F.	1 in.	0.0035
30 deg F.	1 in.	0.0035
140 deg F.	1 in.	0.0035
140 deg F.	2 in.	0.0070
140 deg F.	3 in.	0.0105
140 deg F.	4 in.	0.0140
140 deg F.	5 in.	0.0175

Shape is also a consideration, for a long narrow panel need not be as thick as a square panel of the same area.

Curvature should also be considered since over a slight bend in Plexiglas, it will add to the thermal stresses. It should be remembered, however, that in forming a three-dimensional mirror, the Plexiglas is stretched and is therefore bent out in a degree dependent upon the extent of the strands.

Rods converted to the panel will also add rigidity and strength according to the thickness and position of the rods.

The method of installation will in itself affect the choice of thickness in a major way. If the edges are to be bolted, undersized tube Plexiglas will automatically be required. However, reducing edge clearance allows the edges will make possible the use of thinner material in the rest of the panel.

If the Plexiglas is installed in a dry

environment it is dependent on many factors, most of them beyond the scope of this article. To mention a few of the more important ones, the size, for example, is important because the more completely the panel is bolted, the less likely it is to pull out and thinner material may therefore be used.

The pressure differential between one surface of the panel and the other is also important. In aircraft installations, this factor is dependent on aerodynamic considerations which are, in turn, dependent on the location of the panel on the plane and on the speed of the plane. Since the theoretical maximum differential in these cases is approximately 15 lb per sq in, we have determined the deflection caused by this pressure at the center of 12-in. diameter tube of Plexiglas of various thicknesses. The data below are to be considered only at a point panel. In an aircraft, the reader should consider all of the other factors mentioned above.

Thickness of rod in diameter of tube	Deflection in inches	Deflection in feet
120 in.	0.0001	1/1000
110 in.	0.0002	1/500
100 in.	0.0003	1/333
90 in.	0.0004	1/250
80 in.	0.0005	1/200

#### CHANNEL AND CLAMP MOUNTINGS

Figures 3 and 4 illustrate two methods of holding or securing the glass. Channel and clamp installations are preferable to the use of nuts and bolts, and are definitely superior to distributing screws.

In the type of mounting the principles presented are:

1. The clamped should be increased to prevent free linear expansion and contraction of the Plexiglas relative to the frame.

2. When installing Plexiglas, care should be taken to keep the clamping action uniform over all of the area clamped.

3. The clamps should be deep enough to hold the Plexiglas firmly in place during and through contraction. A safe rule is that Plexiglas panels up to 12 in. in area should extend over the channel 60 in. plus the contraction distance (.002 in. times the length of Plexiglas); larger panels, 10 in. plus contraction distance.

In calculating these dimensions, remember that these numbers are for panels up to 22 in. long and 40 in. in longer panels.

#### SIMPLE CHANNEL INSTALLATION

##### Figure 3

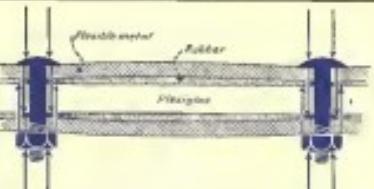


Figure 3. Flexible metal strips after applied stresses to concentrate on the Plexiglas around bolt holes. In practice, all clamped members are apt to be somewhat flexible—hence the need for spacers and other devices to protect the Plexiglas from direct pressures which may cause cracking and failure.

Figure 4. Concentric stresses applied at washer are transferred by outer rigidified bolt sheet stresses acting on the Plexiglas at edge of washer.



## FLUSH CHANNEL INSTALLATION

Figure 4

One of the advantages of Plegglas is that it can be routed along its edges to make possible the type of mounting shown here. The plastic is held securely along a rib. The plastic is held securely yet the metal surface is flush with the mounting frame.

The corner of the shoulder of the rib should have a slight radius to reduce the danger of a rivet's tearing or that part of the fabricator can practice that effect by going down the sharp edge of the corner of the rib.

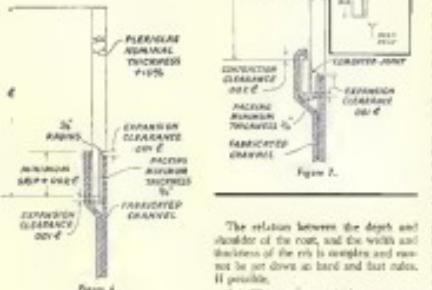
The outer edge can be adjusted to maintain clear tolerances ( $\pm .010"$ ) at either the depth or the toe of the rib. Because of thickness variations in the sheet, it is not possible in a single routing operation, to maintain these tolerances in both toe and depth. When both these dimensions are critical, a second routing operation is necessary—with a corresponding increase in fabrication costs.

### FLUSH INSTALLATION WITH RIB

Figure 7

The Plegglas may be gripped more nearly—vertical, utilizing the advantage of a built-in ribbing of a reinforcing rib is cemented to the edge and clamped as shown so that the rib is held securely.

In assembly, use rubber strips cemented to aluminum on one side. This packing can easily be removed around the edge of the Plegglas and will stay in place while the panel is being assembled.



The relation between the depth and shoulder of the rib, and the width and thickness of the rib is complex and cannot be set down as hard and fast rules. It possible.

(a) The minimum thickness at any point in the Plegglas assembly should

not be less than the thickness of the Plegglas panel.

(b) The rib should be roughly twice as wide as the thickness of the Plegglas, since the tensile strength of Plegglas is approximately double its shear strength.

(c) The rib should not be the same width as the rib, i.e., the edge of the rib should not be opposite the end of the rib, if maximum utilization of strength at this point in the assembly is to be avoided.

### ANNUAL RING INSTALLATION

Figure 8

For strip-grooved sections such as tubes and pipe, the type of installation shown here has proved successful.

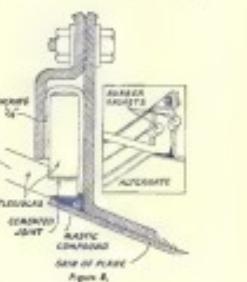


Figure 8

A Plegglas annular ring is cemented around the whole circumference of the nose of rib. This circumference must first be routed as shown in the sketch so that the two surfaces to be cemented together will be flat and so that the rib will be flat when the corner is formed.

Once the rib is set up in position, it will be along the Plegglas shell, as indicated by the arrow on the sketch. The annular ring sits as a lever, multiplying the bonding moments set up in the metal clamping ring. To minimize that lever action, the edge of the ring should follow, as closely as possible, the joint between the annular ring and the shell.

To guarantee other installations, the lever action may be used to advantage by inserting round washers at the top and bottom. As pressure increases, these gradually become tighter and hold the joint more effectively.

The outer edge of the Plegglas shell is routed so that the surface may be

welded after the metal work is completed and in this it may expand radially.

### PATENTED CHANNEL INSTALLATIONS

Figure 9

The patented frame shown here is often used as a type of a number of simple installations which have proved practical on many planes.

It consists of an aluminum extrusion which is held or riveted to the skin of the plane. A aluminum frame, which carries or protects the panel, is held in place by rivets or cemented to the skin of the plane and the Plegglas placed against

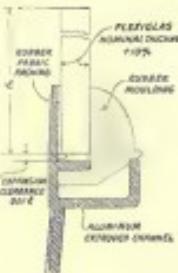


Figure 9

the aluminum extrusion as in the shape of a very flat wedge so that other parts of Plegglas may slide along it freely when expanding or contracting.

It also has a shoulder to prevent direct pressure on the Plegglas. This shoulder holds directly to the reinforcing member. A T-joint is used in one-out-of-the two cases for the rib and body.

This type of installation is, of course,

possible only with thicker Plegglas sections where the edge of the sheet can be located. This levering makes possible a flush flat surface, as advantage over the H-channel installation shown in Figure 3.

In practice, this type of mounting is often used only on one or two sides of a Plegglas section; the other sides being mounted in a channel or by some other method.

Note that the Plegglas is held by the uniform clamping action of the rib and that the possibility of breaking or concentrating stresses is therefore removed. This type of installation is particularly for permanent cabin construction as well as for low altitude planes.

Remember, though, the majority of the aircraft now in service are of the riveted type. If this type of installation is used, there will be other complications for aircraft safety.

### WEDGE SECTION INSTALLATIONS

Figure 10

When two Plegglas panels must be bolted edge-to-edge and supported along these edges, the type of installation shown here may be used.

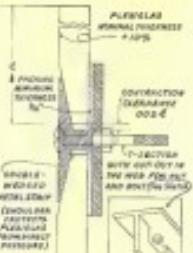


Figure 10

be concentric with the holes in the frame so that the greater relative expansion of the Plegglas will not cause loading at one edge of the hole.

5. Use conventional tube spacers, shank bolts or rivets, cup nuts or some other device to prevent the Plegglas from direct pressure or distortion.

### RIVET AND SPACER INSTALLATION

Figure 11

This type of installation can be used when riveting a bolt or rivet to the panel surface. A saddle spacer protects the Plegglas from direct pressure. Since this spacer is integral after the Plegglas is in position, assembly is quite simple.

A modification of this installation calls for the use of a long-shear screw or shoulder rivet. This modification would differ from the mounting shown in Fig. 11 in the holes drilled in the metal channel members. Here both holes are of the same diameter, as in Fig. 10, one hole must be smaller than the other.

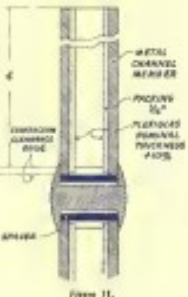


Figure 11

The length of the spacer is calculated to allow for variations in the width of the channel and the thickness of the Plegglas and of the rivet packing.

Note that contraction clearance is allowed around the bolt so that in case of extreme temperature changes, the Plegglas will not bind and crack off.

In this and other rivet and bolt installations, the recommended distances from the hole to the edge of the Plegglas is the same as the recommended depth of grip in the cleated installations.

#### HOLE AND SPACER INSTALLATION

Figure 12

Another method of mounting, which also makes use of a tubular spacer to protect the Plexiglas, is shown here.

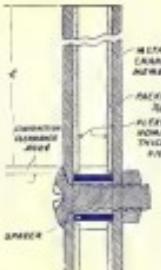


Figure 12

To eliminate spacers, it is possible to use a shoulder nut as shown in the sketch. A shoulder nut can control all forces as used in the case may.

This mounting requires that the cross hole in one channel member be larger than the corresponding hole in the other member. Each member may be drilled separately and assembled later in a way so that the holes are concentric. To drill such holes, a simple operation like the channel is assembled. After each member of spacers has been assembled, respectively, a shoulder extension, relieved, or not cut, counterbore concentrically, or step-drill. The sketch illustrates one type of attached dual-cut bit.

#### ANHILAR RING AND BOLT INSTALLATION

Figure 14

In this case the spacer is equal to the inside width of the channel. This permits the use of counterbore screws as well as rivets, without reducing the

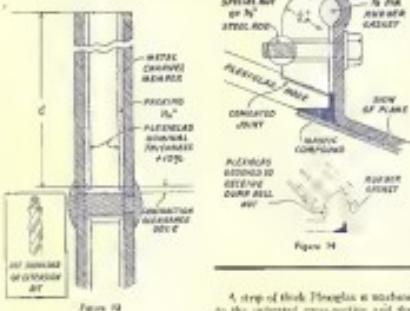


Figure 14

A strip of thick Plexiglas is bonded to the insulator cross-section and then forced to follow the circumference of

the insulator. Then counterbores are also made on the sides so that a will fit the insulator well on the outside. Once fast it can be fastened after all metal work is done. The ring is cemented to the insulator and the required holes drilled through it from below.

The shoulder nut and the shape of the ring prevent the insulator to rock slightly when the cable is pressurized or when the Plexiglas expands or contracts. The rubber gasket under the insulation prevents light. So that excess pressure will not leak. Set on the wire, but it is threaded along only a small part of its length.

#### BOLT INSTALLATIONS FOR SMALL SECTIONS

Figure 15

For small Plexiglas sections carrying very light loads, the simple construction shown here may prove satisfactory. It

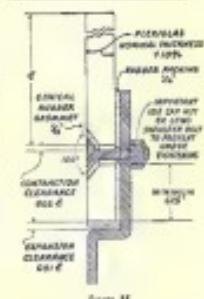


Figure 15

should not be used under any other conditions.

In any event it should be used only where a cap nut, long-shank shoulder screw or some other device is intended to prevent pressure on the Plexiglas. The coarse rubber grommet does not offer sufficient protection for the Plexiglas.

Note also that the head of the screw should have a flat angle. A sharper angle necessitates the wedge action of the screw head which tends to rip the Plexiglas.

A strip of thick Plexiglas is bonded to the insulator cross-section and then forced to follow the circumference of



Fig. 2 Actual photograph of working at the Douglas factory

Clips. Fig. 3. Workers here are inserting the fuel tank in the wing.

## New Gas Tank Insulation Fastener

By ELMER WHEATON

Assistant Research Engineer, Douglas Aircraft Company, Inc.

UNTIL QUITE RECENTLY it had been our custom to hold gas tank insulation to the wings in our attack bombers by means of a special coarse or coarse coating. While this method of insulation was satisfactory, we felt that it could be improved.

In discussing this possibility of improvement with the subcontractor we succeeded in securing from them an improved new Speed Clip that is designed to hold the insulation and avoid the use of cement or coarse coating. These Speed Clips are formed so that they may be warped in place to hold the insulation firmly in position during and prior to the installation of the fuel tank piping and tanks.

We found the Speed Clip retained later and easier. This clip being made of 26ST aluminum with fine diameter primary coating, holds the insulation to the wings satisfactorily without warping. Many more layers of plane have already been used since the adoption of this new assembly method. The process of manufacture of these Timmerman

Speed Clips is equally as interesting as their application. Code of 26ST aluminum step stock are fed into high speed presses where they are bowed in progressive stages, as shown in Fig. 4.

After the Speed Clips are formed they receive a coating of zinc aluminum paint. Fig. 5 shows how the clips are placed in racks to prevent distortion prior to

expansion and packing. The clips are given one heating and cooling saturation on a test gage as shown in Fig. 6, three carefully packed in "egg crates" type boxes for shipment.

This is but one of the many ways in which subcontractors have supplied their engineering and production facilities to the advancement of aircraft assembly.



Fig. 4 Drawing the stainless steel before the paint band where the shear is operating. The wire takes place and entering the forming dies. The clips are cut off and defined while the heat gage which the operator uses constantly to check the Speed Clips for possible defects. Below Fig. 5. The clips are placed in racks to prevent distortion prior to heat treatment and packing. They are heated on a test gage, then packed in "egg crates" boxes for shipment.



## **Designing Propellers to Meet Performance Requirements**

**Propeller installations are vital to the achievement of maximum airplane design performance.** This article describes the factors that are considered in coordinating propeller design with airplane design.

**By HAROLD H. WARDEN**

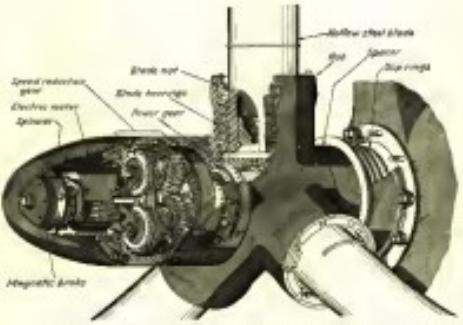


Fig. 1. Get-away view of a typical Hornblende-weld *Cortite* stenite porphyroblast.

**W**HEN an airplane manufacturer decides to produce a new type airplane, he has a definite goal in mind. The new aircraft may have to meet performance requirements of the Air Corps, the Bureau of Aeronautics, Civil Aeronautics Administration, an airline, or his own organization's design specifications. In any event, the new plane is being built as a special task, in addition to being an improvement over all previous aircraft of its class.

To achieve this objective, it is necessary that each part of the aircraft be as efficient and streamlined as is possible when taking into consideration such factors as weight and space. Framework as the principal parts of the aircraft are considered, in addition to the aerial structure itself, to be the engine and

This article is primarily concerned with the iteration of propeller design with airframe design only.

To disseminate the new aircraft design it is first necessary that the aircraft manufacturer consider the aircraft requirements specified by his customer. This information includes facts on the type of aircraft (load plane, long range transport, pursuit, etc.), the degree of importance of its performance as takeoff, climbing, cruising or high speed, plus many other details pertaining to performance and cost.

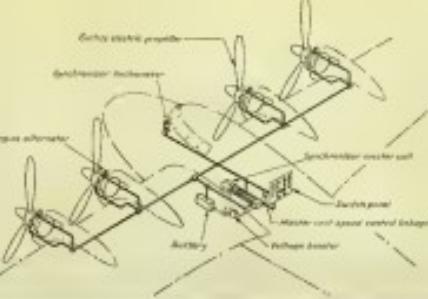
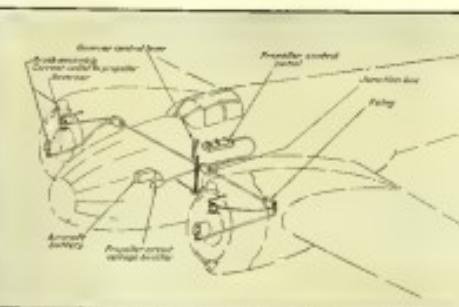
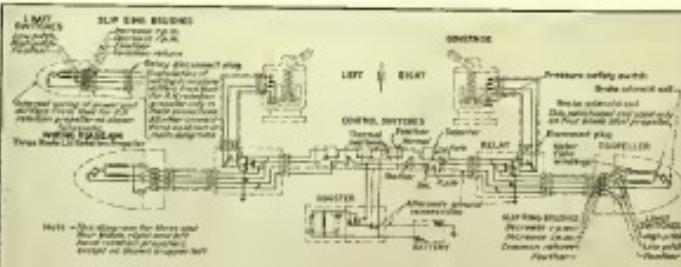


Fig. 3 Schematic diagram of a Faraday electro-propulsive acceleration system.



2. Schematic installation diagram of Curtis electric propeller generator system.



4. Schematic wiring diagram of the propellerless generator at a twin engine aircraft electric propeller installation.

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can be of major importance, particularly if the cockpit is to be operated from untrained flying tests. A typical design of a Curtis electric propeller with hollow steel blades is shown in Fig. 1 and 5.

From the results of the aerodynamic propeller performance study indicated by the propeller engineers, it is believed that a propeller which is designed to obtain the greatest power output needs to result in best airplane performance using the most suitable propeller efficiency. As a result, it is makes the final decision as to which model propeller will be specified.

If the propeller selected is a new design it must necessarily pass a rigid test-shed endurance run, usually conducted with an engine at rated RPM, to be approved by the CAA, Air Corps or Bureau of Aeronautics. Even though it is a "new" production model, a new design tested on a certain model may not be directly applicable to another aircraft model. Therefore, vibration and strength tests for approved use, usually conducted during final flight test on the "X" model or first airplane of initial installation.

In the case of the Lockheed Model 10 (Fig. 4), it was found best that a three-bladed hollow steel propeller be used and that the left propeller should rotate counter-clockwise while the right propeller rotates clockwise.

On the Martin B-26 medium bomber (Fig. 2), two propellers were four-bladed hollow steel, right-hand counter-clockwise clockwise. Due to the severe operating conditions, the left propeller diameter, being larger, was advantageous to utilize the higher weight ratio of the four-bladed propeller.

Now that the propeller itself has been selected it is necessary to determine the type of propeller control system compatible with the aircraft under design. The Curtis electric propeller installation provides great diversity in this respect, particularly as any one of the three present control systems is easily adaptable to various types of installations. As will be noted (Figs. 3 and 4),

a remarkably small amount of wiring and control units is required for the proportional governor system, or for the automatic governor system due to the automatic synchronization feature. Since each installation presents its particular problems a complete analysis is necessary.

The automatic synchronization control system (Fig. 2) has certain distinct advantages and disadvantages over the general use of the proportional system.

Another Curtis electric propeller control system which is sometimes used in the remote control governors (Fig. 3) is the constant current control panel for the pilot and engine engineer. Both methods of standard control systems are not unusual and can usually be incorporated into the control specifications.

Recent trends in new airplane development have been toward the use of general test rigs which duplicate power plant installations details and power testing of individual engines and entire aircraft. Performance propeller blade loading, maximum torque and material tests can be conducted as part of the test program on the ground rig.

### **FUNCTIONAL PROPELLER REQUIREMENTS**

It can now be assumed that the basic propeller and its controls have been designed and fabricated consistently with the aircraft and its engine, all of which are now ready for the initial propeller installation.

Aerodynamic engineers are almost uniformly specific in their requirements of the propeller and control to attain the high propeller efficiency by reducing the profile drag. The use of spinners is becoming more general for the high-speed aircraft, where improved engine cooling results. Figs. 6 and 7 illustrate typical spinner modifications on the liquid-cooled and air-cooled engines, respectively.

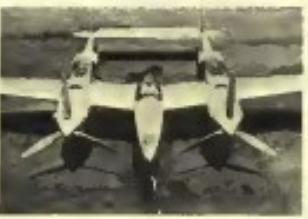
Blade shear cuffs, which recently have been developed, are specified for the most part on air-cooled engines in that their use is believed to increase the life of the propeller at the point of low speed, which acts as engine cooling. (Turn to page 202)



Fig. 1. A partially assembled three-blade hollow steel Curtis electric propeller.

Fig. 2. Lockheed P-38 interceptor equipped with Curtis electric propellers.

Fig. 3. Martin B-26 medium bomber equipped with Curtis electric propellers.



AVIATION, APRIL 1940



# Producing Struts For the P-38

By WILBUR G. WOOD

Chief Engineer, Aircraft Sheet Metals Manufacturing Co.

This article on the production of landing gear struts for the Lockheed P-38 Interceptor is a dramatic illustration of the contribution which can be made to military aircraft production through subcontracting.



1. Cleaning of Lockheed P-38 sheet metal features of main and nose struts of the landing gear.

**N**OW ROLLING OFF the production lines as rapidly increasing numbers the Lockheed P-38 interceptor aircraft, one of the most advanced American fighter aircraft produced to date, is taking off in the United States.

All of the loads in taking off or landing the P-38 is carried by the landing gear, which is of tricycle type. Both main and nose struts for the P-38 landing gear are manufactured by a subcontractor to Lockheed design. The P-38 landing gear is characterized by its simplicity and ruggedness. But only does this insure reliability in operation, and simplify maintenance problems,

but it helps speed manufacturing. Basically there are but two parts to the P-38 main landing gear strut. These are the shock absorber cylinder, which carries the load at all times, and the piston which operates in the cylinder and which carries the wheel at all lower end. Of course there are numerous nuts, bolts required for full operation. Construction with the extreme simplicity of this piston-cylinder mechanism is the rather common practice ahead of separating the strut into a load carrying member and a shock absorbing unit, resulting in many more parts. Some

designers also prefer to use heavy ring springs in the strut to carry compression loads instead of relying on air pressure, as is usually done.

## MANUFACTURE IS SIMPLE BUT HIGHLY CONTROLLED

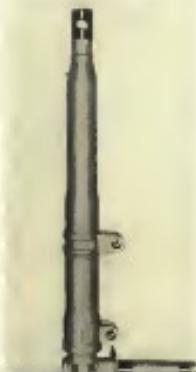
In order to justify the simplicity of design and manufacture for P-38 type sheet metal gear unfolding struts, the supplier that manufactures he conducted with extreme care and accuracy. Both manufacturers can now locate piston bars treated and ground accurately to inspection, in addition to a high quality of machine work. Two examples of operations other than machining will illustrate this. In hot working the piston bars, the bars, the are heated in special furnace equipment which protects them from room atmosphere and so practically eliminates scale formation. This eliminates vulnerability to close control of dimensional tolerances. A further example is the practice of hard chrome plating the wearing surface of the piston tube. The piston is first plated on a lathe, then ground to close tolerances and finally buffed. Final operations are hard chrome plating to within .002 of spec. for flatness and wear.

Importance of machinery to production of the P-38 struts is illustrated by comparing rough and finished weights of the major strut parts. The strut cylinder, a heavy stainless steel chrome molybdenum tube, weighs 186 lb. in the rough and only 45 lb. when finished, including the weight of two forged legs which are welded on to the ends of the manufacture. The piston cylinder is produced from a forging which weighs 136 lb. in the rough and only 28 lb. finished, including a torque flange which is welded on.

## STRUT CONSTRUCTION

Since the P-38 landing gear is of the cycle type, the main landing gear struts are located in rear of the C.G., being attached to the seatplane structure by a fulcrum. The struts are semi-cylindrical, with drug brace running from about the mid-point of the strut, and rods rods carried by large slots extending up and outward from the same mid-point fitting. Retraction is accomplished by a hydraulic cylinder which operates on the drug strut, driving the landing gear forward and up into wheel wells which are fully formed when the gear is retracted. These brace struts and the assisting cylinder are not produced by us, however, so to concentrate all our production facilities on the strut well.

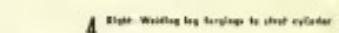
There are two main chambers in the strut cylinder, the piston leg operating in the lower cylinder, which is filled with oil, while the upper chamber serves



2. A completed main strut for a P-38 landing gear.



3. Above: Special Mennen engine lathe equipped with precision tool bar for holding multiple O.E.M.'s.



4. Right: Welding leg forgings to strut cylinder.



5. Left: Main bearing gear diameter simultaneously in main strut on special lathe machine.



position is 45° to front center of the wheel, following in center of the wheel axis. Maximum O.D. of the strut is 54 in. Both the cylinder and piston are of chrome molybdenum steel which is heat treated to a strength of 180,000 psi minimum. Brass bearings are provided on the upper end of the piston and lower end of the cylinder so that sliding metal contact occurs at brass against hard chrome plate or steel. Between the piston and the fluid is by means of a clevis-type piston rod which is supported in the lower end of the cylinder just above the bearing. Proper alignment of the wheel end is maintained by torque links connecting the piston with the cylinder.

The piston member is machined from a solid forging which incorporates a knuckle at the lower end. This knuckle is bored out to receive the wheel axle, which is pressed into the forging. The piston is machined, ground, and honed in a false cylinder, closed at the upper end by means of a brass piston head which also serves as the upper bearing. A torque plate is welded to the knuckle end of the piston serving as a support for the bridle mechanism.

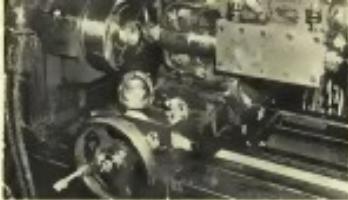
A clevis is also secured in the lower end of the cylinder to serve as a stop for the piston when it fully extended position. Below this sleeve is the cylinder passing, the lower bearing, and a retainer.

## IMPROVEMENTS OF CONSTRUCTION

Representative of the last America's practice in shock strut design, the P-38



6 Face boring the cylinder chamber in main strut on Anheuser engine lathe.



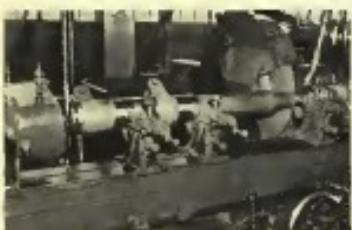
7 Thread milling piston head and plug on a Goss Bradner thread mill.



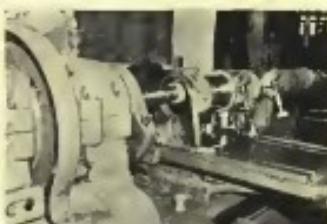
8 Left: Heat treating department, which includes two electric furnaces, a quenching tank and work pre-heating heat.



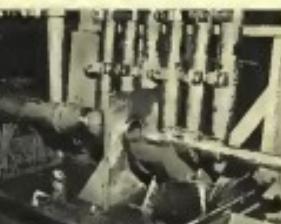
9 Below: First cylinders, pre-heated to 100 deg. R, by an Adams automatic electric furnace, are deducted through automatic doors.



10 Left: Grinding a main cylinder on a Laddie machine.



11 Lower Left: Finish honing holes in main and nose strut.



12 Below: Grinding the packing gland chamber in the large and sti main strut with Heald grinder.

shot is quite conventional throughout. Its efficiency as a shock absorbing unit is the result of careful proportioning of the air and oil cylinders, and of the offset between them, based on long experience with existing designs. Not only is the cost of this design more economical, it is more compact, and more reliable, compared with more complex types, but it is also less susceptible to damage from gun fire or shell fragments. We know of no case of such a strut having been penetrated by an enemy shell or bullet. In fact, the hardened steel seat of the strut, made using the air work as a quenching medium, is fully equivalent to the armor plate normally used to protect vital parts of an airplane. And the shape of the strut cylinder would tend to deflect any bullet or fragment that did strike squarely. Finally, even if the strut were jarred, a wall will function successfully without air pressure.

#### HOW QUANTITY PRODUCTION IS ACHIEVED

In achieving quantity production on P-51 aircraft, the company has built and equipped a complete new factory designed specifically for this work. This plant is half again as large as the portion of the factory formerly devoted to engine manufacture. Furthermore, under the pressure for all-out strafe production, we have converted a large part of the engine plant to strafe work.

To illustrate the scope of the manufacturing processes involved, there follows a brief description of the operations performed on the main strut cylinder.

The upper end of the strut tube is reduced by sawing to approximately half its original diameter. Then both ends of the tube are rough-faced to approximately length.

The cylinder O.D. is turned on a special monocoque engine lathe, equipped with a special mandrel which restricts the tool in cutting 12 different diameters, and tapers between them along the length of the cylinder. The machine performs both rough and finish spot operations. Rough cut for this operation is about .5 in. and the finished cut about .1 in. The tube has a 27° bevel at each end, and a shoulder between bevel and against the profile bar in an air cylinder. Following this, the upper end of the cylinder is drilled for location of air and oil filter plug.

Two forged fittings are welded to the cylinder with a Laddie arc welder. On the upper side of the cylinder is a ring fitting with two sets of lugs, one extending forward which carries the lower end of the strut brace arm and the other extending laterally to the outward side to carry the rate brace arm. This lug-



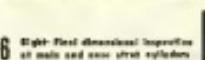
13 Milling both sides of lug simultaneously at nose and at nose strut with a Milwaukee single spindle production mill.



14 Right: Drilling main cylinder with Cerkov radial drilling machine.



15 Left: Threading main cylinder on Ba-Cell-O grinder.



16 Eight: Final dimensional inspection on main and nose strut cylinders.



17 Below: Nose strut being given cut to test on Heald press.

ing is shipped over the cylinder and welded into place. The lower fitting is a strap type, extending about half-way around the strut and carrying lugs for the attachment of the upper torque tube. This is welded to place while positioned in a special fixture. The upper and final side lugs are also welded in place near the upper end of the cylinder.

Clean metallurgical control is exercised over the welding operation, maintaining constant check on the composition of the metal and welding rod heat of weld. After tack welding, the cylinders are preheated to 200 deg. F. in an automatic electric oven and are then exposed to a power resist welding jig which may be positioned to provide

(Turn to page 260)



## Timetable—for the OFFENSE!

CIVILIAN AMERICA is engaged in a supreme battle of production. There is no time for delay—agreements—extenuating circumstances. We have no choice but to work with every man, hour, with every machine, with every ounce of energy and muscle that we can bring to bear in this vital offensive drive.

We can't talk 60,000 engines into the skies for 'em. They must be built minute by minute, part by part, through thousands of man hours to find assembly. The job is big. Stakes are high, and time is short.

To Goodyear Aircraft has been assigned the task

of producing thousands upon thousands of sub-assemblies vital to America's air offensive. Our War Production Commissar No. 1 might well read, "The President has set our goal. We must and will do better."

Goodyear's thirty years' experience in research and engineering, its facilities, resources, man power are dedicated to the aircraft production offensive. Nor do we differ in this from our brothers-in-arms of the aircraft industry. To them we pledge increased production of parts and sub-assemblies that America may be first in the sky—with 60,000 military airplanes—this year!



AVIATION April, 1942



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*Master machinists finishing Goodyear airplane wheels in Goodyear factories*

PROPERLY designed wheel equipment—and that includes hubs, rims and tires, as well as the wheels themselves—is more important than ever before on today's faster, longer trips. Size, weight, strength and balance of this equipment are all major factors in modern airplane construction.

Goodyear produced the first complete airplane wheel-assemblies thirty years ago and pioneered most of the improvements that are standard specifications today. The low-pressure Airwheel-type tire, the hydraulic disc brakes, lightweight magnatite and aluminum-silicon wheels and dual-seal tubes are all Goodyear developments.

As a result of long research conducted through years when rewards were slight, Goodyear today is producing wheel-assemblies that exceed the needs of the most advanced aircraft yet projected. Goodyear is ready now with proper wheel equipment for the giant superaircraft just taking shape upon acres of drawing boards.

*Advertisement Department  
THE GOODYEAR TIRE & RUBBER COMPANY*



AVIATION April, 1942

## ***Design Charts for Tubes Subjected to Bending***

**W**HILE WORKING on the stress analysis of landing gear shock absorbers, the writer became impressed with the thought that something could be done to simplify the stress analysis of tubes subjected to bending. The idea of selecting a reasonable size of example

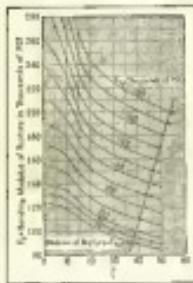


Fig. 1. Sealing Methods of Sputtered-Chromium Molybdenum Steel Tubing

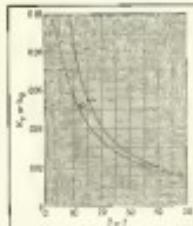


Fig. 2. Chart for determining the mean modulus of either of the two diameters by a varying well thickness.

ing its sensitive modulus, as comprising its other means of determining its modulus of safety, only have to repeat the entire process until a site was the measured which yielded a safe positive result. This approach was termed for a given modulus moment load treatment and take distance there is only one will find those that will yield a safe enough of safety. The method outlined below enables the engineer to determine the safe modulus, without calculating the safety modulus of all the sites, and thus reduce the number of regions of response. For non soils modulus value that corresponding to an average of safety, can only readily determine the ranges of safety in the three sites.\*

Walter S. Blodgett

margins of safety or like stress ratios.\*

$$S = \text{Outside diameter of tube}$$

$$d = \text{Inside diameter of tube}$$

$$P_s = \text{Allowable bending stress (loadings of required)}$$

$$S_d = \text{Design bending stress} = \frac{S}{K}$$

$K_2$  = Constant for determining average modulus of resilience. See Fig. 3 and "Eq. 4.7."

Longitudinal view of tube (See Fig. 3 and "Big" (b))

$M^1$  = Building moment which fails in bending design

LM #1 = Margin of Safety  
per -- Produk per impian seba-

1 - Wall thickness

Reproduced in Fig. 1, is a family of curves for tubular steel members having various heat-treatments. The bending modulus of rupture is given as a function of  $\frac{B}{d}$ . When  $\frac{B}{d}$  is equal to 2, the member is a cold bar.

From a glaze at these series it will  
-P. B. Mander and R. J. Rydin, *Science*, **200**,  
the paper is in the *Canadian Conference Proceedings*,  
April 1964, 1964.

Design engineers will welcome this simplified method of determining wall thickness of tubes subject to bending to yield a desired margin of safety. This method eliminates the necessity for computing section modulus, fiber stress and modulus of rupture.

By WALTER G. SLATTON

**Chief Response:**  
Centre, World Technical Institute

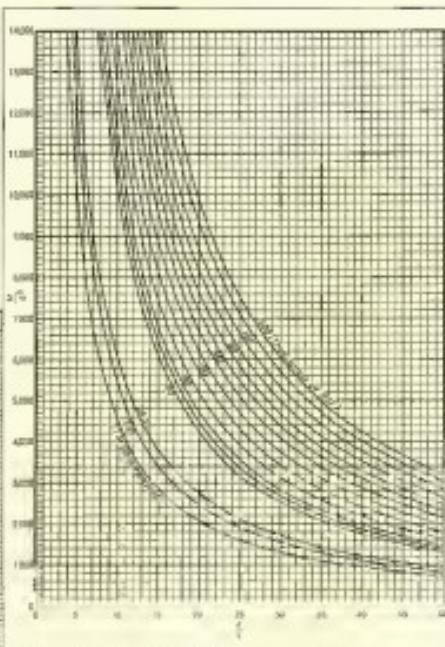
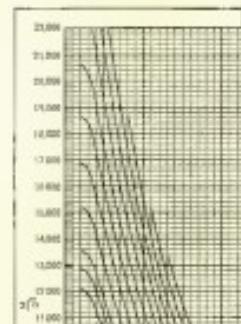


Fig. 4 Above: Stress-strain chart for tubes with given inside diameter. This chart and Fig. 3 are obtained by multiplying the ordinates of the curves in Fig. 1 by those in Fig. 2.

Fig. 3. Stress analysis chart for tubes with glass outside diameter. This chart gives the factors for determining the wall thickness required for zero margin of safety, or for determining the margin of safety and stress ratio obtainable from a tube of glass with thickness  $t$ .

would appear to be sensible. One way was to compute the section modulus of the member, using either tables (where available), or by formula:

$$S = \frac{\pi}{16} \left( \frac{D^3 - d^3}{D} \right) \quad (1)$$

The computed bending stress may be determined from the equation:

$$\sigma = \frac{M}{S} \quad (2)$$

Knowing the diameter and wall thickness of the tube, the numerical value of  $\frac{M}{S}$  can be obtained. Reference to Fig. 1, the allowable bending modulus of rigidity in thousands of pounds per square inch can be found. This is given as  $F_1$ . The margin of safety is

$$(O.S.) = \frac{F_1}{\sigma} - 1 \quad (3)$$

It must not be negative, so the wall thickness must be made thicker. It would not be a large positive value as the wall induces a needless heavy structure. After obtaining the margin of safety, the designer must remember his original guess at the size of tube required. The only way makes another pass to obtain a margin of adequate strength but not excessively heavy. This trial and error, or guess and check procedure is a sure way to success and frequently the solution of a problem that is seemingly hopeless.

For a given character index it would be desirable to be able to compute directly the wall thickness necessary to give a zero margin of safety. Such a procedure is outlined in the following paragraphs.

The section modulus of smaller tubes (since  $\frac{D}{d}$ ) varies as  $D^2$ . The section modulus of tubes of the same diameter but having different wall thickness varies as a function of  $\frac{D}{d}$ . In place of Eq. (1) we can therefore write:

$$S = K_1 D^2 \quad (4)$$

The variation of  $K_1$  with  $\frac{D}{d}$  is represented by the lower curve of Fig. 2. If desired, the section modulus can be computed along the inside diameter. This is done as follows:

$$S = K_2 D^2 \quad (5)$$

The value of  $K_2$  with  $\frac{D}{d}$  is represented by the upper curve of Fig. 2. If desired, the section modulus can be computed along the inside diameter. This is done as follows:

With  $I_1$  and  $I_2$  are also functions of  $\frac{D}{d}$ . This suggests that the curves of Fig. 1 and of Fig. 2 might be combined to make a passes as to facilitate a more direct procedure in determining the cost of tube desired. Actually, by multiplying the ordinates of the curves in Fig.

1 by the ordinates of the curves in Fig. 2 along the  $\frac{D}{d}$  scale, Fig. 3 is obtained. The ordinates in Fig. 3 represent points per square inch stress which can be expressed as

$$\sigma = \frac{M}{S} = \frac{M}{K_2 D^2} \quad (6)$$

The ordinates in Fig. 3 represent a dimensionless constant. The product of the ordinates of Figs. 1 and 2 is

$$2 = \frac{K_1}{K_2} = \frac{M}{D^2} \quad (7)$$

and since  $\frac{M}{D^2}$  for the various bend-test-sections is provided that the ratio is of reasonable proportions,  $\frac{M}{D^2}$  will have a numerical value of between 1,000 and 20,000. The results of using Fig. 3 are identical to that of using Fig. 2, but much less is said.

The use of the curves can best be illustrated by example.

#### Example

Given: A portion of a cantilever bending gear shock absorber having a bending moment of 250,000 in-lbs. It is desired to make the tube 4 inches in diameter and in order to keep the weight down, the tube will be held to 180,000 psi ultimate tensile stress.

Find: (a) The required wall thickness for zero margin of safety;

- (b) The margin of safety and the stress ratio, assuming that it is desired to make the wall thickness 0.125 in.

#### Solution

$$(a) \frac{M}{S} = \frac{250,000}{\sigma} = 4,000$$

This point is designated as A on the  $\frac{M}{S}$  scale of Fig. 3. Draw a horizontal line and extend it until it intersects the 350,000 psi curve at point C. Drop a vertical line from B to the  $\frac{D}{d}$  scale at C. The value of  $\frac{D}{d}$  for point C is 35.7. The required wall thickness for zero margin of safety is

$$\left( \frac{D}{d} \right) = \frac{4}{35.7} = 0.112^*$$

(b) For a wall thickness of 0.125 in.

the value of  $\frac{D}{d}$  is

$$\frac{D}{d} = \frac{4}{0.125} = 32.0$$

point D is on the  $\frac{D}{d}$  scale. Draw a vertical line up to point E on the 350,000 psi curve. From E draw a horizontal line to F on the  $\frac{D}{d}$  scale. Point F represents the value of  $\frac{D}{d}$ , where  $M'$  is the bending moment that can be resisted when the wall thickness is 0.125 in. The value is 47.0.

The margin of safety is determined as follows:

From 1:

$$\left( \frac{M}{S} \right) = 2 = \frac{4,000}{350,000} = 0.007 = 7\%$$

When the problem involves stress ratios the stress ratio,  $R_1 = \frac{D}{d}$ , may be

$$\text{expressed as } R_1 = \frac{\left( \frac{D}{d} \right)}{\left( \frac{D}{d} \right)} = \frac{35.7}{47.0} = 0.750 = 0.009$$

In considering infinite numbers of relatively large diameter and thin wall which are machined inside and out, the matter of manufacturing tolerances should be given careful consideration. The specified tolerances for aircraft structures are quite liberal in many cases. The designer must exercise good judgment and machine parts. Let us assume in the over case, that the outside diameter  $D$  is to be held at tolerances of  $\pm 0.000$ , and that the inside diameter is to be held in  $\pm 0.010$  in. It is readily seen that the wall thickness could be 0.125 in. plus or minus 0.010 in. To insure against a regular variation of thickness that normal wall thickness would have to be 0.120<sup>2</sup> = 0.013<sup>2</sup> = 0.125<sup>2</sup>. Specifically if a margin of safety of 7.7 percent on a stress ratio of 0.029 is desired, the nominal wall thickness should be 0.120<sup>2</sup> = 0.007 = 0.125<sup>2</sup>.

If frequently becomes necessary, as in the case of a shock absorber cylinder, to machine the bore of the cylinder and make the inside diameter that which is necessary to provide sufficient strength for that use, we are concerned with  $d$ , the inside diameter instead of  $D$ , the outside diameter. We may proceed as earlier, but of course to those shown in Fig. 3 in which  $\frac{M}{S}$  is plotted against  $\frac{d}{D}$ . These can be used in the same manner as that described above. A set of curves are contained in Fig. 4.

Example

Given: A cylinder with a bending moment  $M = 250,000$  in-lbs of outer shell, having a wall thickness of 0.125 in and having an inside diameter equal to 4 in.

Find: The required wall thickness for zero margin of safety.

Solution

From 1:

$$\frac{M}{S} = \frac{250,000}{\sigma} = 3,333$$

From 3 the value of  $\frac{d}{D}$  is 3.8.

Therefore the required  $\frac{d}{D}$  for zero

margin of safety is equal to

$$\frac{4}{3.8} = 1.05$$

The outside diameter would be

$$4 \times 1.05 = 4.200$$

(Turn to page 204)



## WHAT MAKES GOOD AIRCRAFT WIRE?

### 1—SPECIALIZED MATERIALS

Aircraft wires are engineered for aircraft use. Not "just copper" but copper with special properties. Not "just insulation" but perlite, glass, asbestos, fiber, "heat breaker" or "heat breaker" or other composite materials. Every ingredient is specially selected — tested — proved best.

### 2—SPECIALIZED WORKMANSHIP

Highly developed processes to give their utmost in quality and speed for defense production. Skilled craftsmanship — exceeding supervision — constant attention to details — comes uniformly on every foot of finished products.

### 3—SPECIALIZED EXPERIENCE

Book of Belden aircraft wire is a treasury of searching, experimenting, testing, testing. Belden has collaborated with aircraft engineers since World War II in developing the most effective ways to make aircraft lighter and more reliable. The Belden wires that meet today's needs

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Under any conditions, Valspar Val-Aero Aircraft Finishes do the job they're built for—and do it well . . . on any part of a plane.

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A complete line of dependable Aircraft Finishes—that meet government specifications in every respect

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MAKERS OF THE FAMOUS VALSPAR FINISHES

# Cleaning Alclad For Production



Mass production spotwelding is advanced by a new method for cleaning Alclad parts.

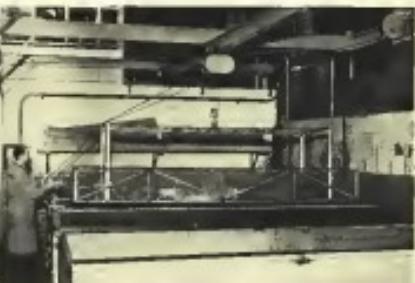
By FRED MORRIS, Research Department Manager, Inc.

**V**IRGINIA is a good word to use when speaking of Fleetwings' progress during the past year. A review of the constant undercover shows that three types of construction are being used and spotwelded: aluminum steel, riveted aluminum alloy, and spotwelded Alclad. Almost 30 percent of the spotwelding being done is on aluminum-alloy parts for coated surfaces.

All of the Fleetwings developments in Alclad spotwelding have been accomplished since Navy Bureau of Aircraft Engineering was convened in 1946 with a contract commanding the construction of the wings which showed a maximum deviation in strength of only 8.2 percent. Since that time many methods have been developed to help Fleetwings to maintain its record delivery of aircraft control surfaces.

#### METHOD OF PREPARING SURFACE

One phase of the problem of preparing two surfaces of Alclad required the development of a method of preparing the surfaces of the metal to secure a reflectively low surface resistance for



In Fleetwings' cleaning operation, parts to be cleaned are placed in a long basket suspended from overhead traveling crane running on the glider bridge. In this manner, basket and contents can be transferred easily from one tank to another.



The basket, into which the parts to be cleaned are put, is made of stainless steel so that it will resist the acidic acid used in the process.

to touch the parts to be welded, and to do a satisfactory job. A number of methods have been formulated in the past few months. The details are set down here for others who may find them useful in the furthering of our national defense.

Where quantities are small, the old reliable method of preparing the surface with a rotating wire brush is used. It is a slow and laborious process, and requires too much manpower for today's requirements, and involves the human element which results in variable degrees of cleaning. Therefore, chemical cleaning processes were investigated to speed up output of parts for spotwelding. Some chemical processes did not give consistently good

(Turn to page 23)



The  
Score at  
**LOVE FIELD**  
**DALLAS**

## 40 Flights ... 40 Planes have fluids

There is a daily average of 40 flights by three airlines at Love Field, Dallas—headquarters for Braniff Airways, terminal for American Airlines and Delta Airline. 100% of those planes have installations of Cuno Filters.

**Y**OUR engine and aircraft build crews have real faith in the Cuno Filter. You may feel that it is the most dependable means of keeping fluids clean—at high speeds, at high altitudes, for long periods of time.

For you have been practically unanimous in your choice of Cuno. Cuno was in on the ground floor of aircraft engine lubrication. Engine builders recognized it as an

opportunity to insure further engine fail-safe due to contaminated fluid or clogged fluid lines. And in the succeeding years, Cuno engineers have satisfied many other aviation requirements. Today, the demands of engine and aircraft builders are largely responsible for the tripling of Cuno's manufacturing facilities.

Among them, the Cuno self-cleaning filter. See illustration at right.

### From Drafting Room to Maintenance Shop

The Cuno engineer serves the industry in many ways—designing filters for individual applications... aiding aviation designers in building Cuno Filters into their blueprints... serving the ultimate operators of the aircraft.

That is why Cuno engineers are *familiar figures* in drafting rooms, near assembly lines, on proving grounds, in airport maintenance shops.

If your responsibility is the protection of lubricated or fluid controlled parts, the selection of a Cuno Filter will be as wise with the entire industry's best judgment.

## protected by CUNO FILTRATION



**Completely Automatic Filtration**

Cuno's self-cleaning filter was developed with the assistance of prominent avionics engineers. A tiny hydraulic motor, powered by the oil of the filter to keep clean, rotates the filter element precisely past cleaner blades which precisely cut out clogged as well as different solids. Fluid systems equipped with Cuno's self-cleaning filters are kept free of sludge and considerable debris, yet all filters and units necessitated cleaning of the pump the only attention required.

KEEP FLOW  ON "GO" WITH

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# Salvaging Power

## In Engine Testing

The problem of efficiently harnessing energy developed in testing aircraft engines is essentially one of how to pump power from a varying-speed source into a constant-frequency system. This solution utilizes a slip coupling between driver and generator.

By G. E. CASSIDY

Industrial Division Department, General Electric Company

**W**ASTE AND DISREGARD of value in industrial processes, even though automatically necessary, will soon or late be eliminated by the use of power systems.

Thus it was that a large engine repair manufacturer not long ago started, as chairman, "Our present methods of testing are not satisfactory. Can we systematize the design which will be economically efficient and which will reduce the loading of large engines easy and simple?"

He continued: "Engines require a constant speed and constant torque requirements. Such requirements can be understood for considerably persons. The only solutions known for producing loading of engines are auxiliary generators, water breaker electric breakers and similar devices, all of which involve disposal of the engine power by complete storage. The first consideration is to convert the engine power into auxiliary power, such as, for example, into electrical power, so that the engine might be connected to the system, and assist in supplying power to other directions of rotation."

It is argued to the driver of adding the power produced by the engine there is but one answer—namely, to pump the power into the power system of the generating plant. The outcome is a new better known as a motor or as a generator. The synchronous machine is brought to speed and synchronized in the same manner as a conventional synchronous motor. Then, the coupling is engaged, so that the synchronous machine "turns over" the engine. The engine is fired and after it is warmed up it is brought to a speed above that of the synchronous machine. This machine, then acting as a generator, is loaded back on the power system by slipping of the coupling. The amount of load is increased in the engine until the speed and the degree to which the coupling slips is reduced.

To illustrate the distribution of engine power, assume that the synchronous machine has a constant speed of 720 rpm and that the engine, engine shown in Fig. 1, is to be run at speeds of 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000, 1050, 1100, 1150, 1200, 1250, 1300, 1350, 1400, 1450, 1500, 1550, 1600, 1650, 1700, 1750, 1800, 1850, 1900, 1950, 2000, 2050, 2100, 2150, 2200, 2250, 2300, 2350, 2400, 2450, 2500, 2550, 2600, 2650, 2700, 2750, 2800, 2850, 2900, 2950, 3000, 3050, 3100, 3150, 3200, 3250, 3300, 3350, 3400, 3450, 3500, 3550, 3600, 3650, 3700, 3750, 3800, 3850, 3900, 3950, 4000, 4050, 4100, 4150, 4200, 4250, 4300, 4350, 4400, 4450, 4500, 4550, 4600, 4650, 4700, 4750, 4800, 4850, 4900, 4950, 5000, 5050, 5100, 5150, 5200, 5250, 5300, 5350, 5400, 5450, 5500, 5550, 5600, 5650, 5700, 5750, 5800, 5850, 5900, 5950, 6000, 6050, 6100, 6150, 6200, 6250, 6300, 6350, 6400, 6450, 6500, 6550, 6600, 6650, 6700, 6750, 6800, 6850, 6900, 6950, 7000, 7050, 7100, 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TABLE II—Allowable Shearing Strengths of 2024 Alclad Aluminum Alloy Sheet (Lbs./sq. in. = 1,600 psi.)

Size of Sheet (in. per side)	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16
1/16	111	166	241	356	501	706	998	1,200	1,400
3/32	82	124	186	281	406	540	754	936	1,100
1/8	70	105	156	231	351	496	696	866	1,036
5/32	56	84	121	186	271	391	551	696	846
3/16	46	66	95	136	195	271	391	506	626
7/32	36	51	74	104	151	221	321	421	521
1/4	30	44	61	85	115	171	241	301	371
9/32	26	36	49	66	91	121	171	211	261
5/16	21	29	39	50	66	86	111	136	166
7/16	16	22	30	39	50	66	86	106	126
1/2	12	16	22	28	35	46	61	76	91
13/16	10	13	18	23	28	36	48	58	71
15/16	8	10	13	17	21	27	36	44	54
17/16	7	8	10	12	15	19	26	32	40
19/16	6	7	8	10	12	15	21	26	32
21/16	5	6	7	8	10	12	17	21	26
23/16	4	5	6	7	8	10	13	17	21
25/16	3	4	5	6	7	9	11	14	18
27/16	2	3	4	5	6	8	10	12	16
29/16	1	2	3	4	5	7	9	11	14
31/16	—	—	—	—	—	—	—	—	—

TABLE III—Shear and Tearing Strengths of Aluminum Alloy Rivets and Studs

Size of Rivet (in. per side)	1/16	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16
1/16	—	—	375	575	875	1,200	1,600	1,900	2,200
3/32	—	—	300	450	600	800	1,000	1,200	1,400
1/8	—	—	250	375	500	675	875	1,000	1,150
5/32	—	—	200	300	400	500	600	700	800
3/16	—	—	160	240	320	400	480	560	640
7/32	—	—	130	190	250	320	380	450	520
1/4	—	—	100	150	200	250	300	350	400
9/32	—	—	80	120	160	200	240	280	320
5/16	—	—	60	90	120	150	180	210	240
7/16	—	—	40	60	80	100	120	140	160
15/32	—	—	20	30	40	50	60	70	80



Fig. 2. Rivet head markings used to indicate composition of rivet material.

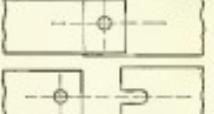


Fig. 4. Symbols denoting diameters of sheet sizes adopted by the Consolidated Aircraft Corp.

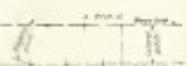


Fig. 5. Diagram illustrating the pitch of rivets used in double rows.

laminates have 1 in. diameter rivets the rivet strengths given in the table may be used. The terms "riveted joints" and "riveted heads" should not be used interchangeably as they are not identical components. All riveted joints and riveted heads are made from high tensile strength sheet aluminum machine screws or epoxy cements are used to make joints which have superior mechanical properties but have lower strength qualities. All riveted joints are made by the techniques outlined in Fig. 1, beginning with AN size No. 10-32, or 820 steel bolts. These can be identified on sight by characteristic markings placed on the head of each bolt as shown by the diagrams in Fig. 2.

Furthermore, all aircraft bolts, with the exception of riveted joints, have so-called "oversized heads." In one of these two ways, an aircraft bolt can always be recognized from machine screws which are left unheaded. Aluminum alloy bolts of 2024 material are identified by two notches on the head of each bolt as shown above. Aluminum alloy bolts of 1227 material are made by the design and processes:

The use of machine screws is not believed in the primary structure of the airplane, nor in the attachment of superstructure and accessories where failure would be of serious consequence. Primary structure must be defined as the

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line of 400 ft/sec. Furthermore, the time in which the sheet will meet likely be a consideration in sheet design one of the factors after which the sheet in any of the cases is bent so that the rivet is allowed to pass.

A more reasonable value for the strength of the sheet in shear is obtained by assuming that the sheet shears along very nearly the outer edge of the rivet hole and the edge of the sheet. The edge distance, from the edge of the rivet hole to the edge of the sheet, is termed the *edge-to-distance* (abbreviated *E.D.*). The use of the *mean* distance is equivalent to the assumption that the rivet is square and has the same dimensions for any side as the diameter of the rivet itself.

The shear strength of the sheet, or the load in which failure will occur, is:

$$T_s = W \cdot F_s \quad \text{where } F_s = A_c / A_s$$

$W$  = Weight of sheet =  $\rho \cdot A$   
 $A_c$  = Cross-sectional area of the sheet along which the shear load is applied =  $2 \times$  true cut distance  $\times$  thickness of sheet

$A_s$  = Thickness of sheet  
 $\rho$  = Density of sheet  
 $\rho$  = Constant of proportionality for true cut strength vs. thickness of sheet

There are two areas along which the sheet can shear, and the equation for true cut strength is obviously:

$$\text{True cut strength of sheet} =$$

$2 \times F_s \times T_s / D = 2 \rho \cdot A \cdot D$

An equation equivalent to this but differently expressed is given in Section ANC-5 for determining the allowable shear stress strength in the eye of a rivet rod, Fig. 9, or Eq. 1.

$F_s = \text{Allowable shearing stress in the eye of lag or rivet}$

$$D = \text{Diameter of eye}$$

$$A = \text{Area of eye}$$

$A_c = \text{Ultimate allowable shear stress of the metal from which the lag or rivet is made}$  (See Fig. 1.)

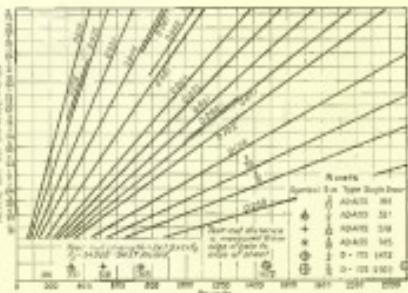


Fig. 11. Curve depicting the true-cut strength of all standard gauges of 305T Alclad sheet.

number of the rivet of from one and one-half to two diameters is maintained between the centerline of the rivet and the edge of the sheet. It is just not feasible to go beyond this. For the reasons necessary to calculate the bearing strength of joints, when using this edge distance requirement, however, it is important that the rivet should be sheared for strength. For design purposes, it is assumed that the strength of 20 standard gauges of 245T Alclad sheet for any given aircraft condition has been concentrated and rounded off to be on the safe side.

True cut strength of sheet =  $2 \times F_s \times T_s / D = 2 \rho \cdot A \cdot D$

An equation equivalent to this but differently expressed is given in Section ANC-5 for determining the allowable shear stress strength in the eye of a rivet rod, Fig. 9, or Eq. 1.

$F_s = \text{Allowable shearing stress in the eye of lag or rivet}$

$$D = \text{Diameter of eye}$$

$$A = \text{Area of eye}$$

$A_c = \text{Ultimate allowable shear stress of the metal from which the lag or rivet is made}$  (See Fig. 1.)

It should be observed from the two formulas given above that the true cut strength is a joint function of the thickness of the sheet, as well as the edge distance. If the thickness is large, the theoretically required true-cut distance is very small. Such small true-cut distances may not be sufficient to prevent bending of the sheet when the rivet is driven, thus causing a weakened and possibly unsafe riveted joint. In such cases, the true cut must be either under-drilled or a lock calculated for the rivet.

In some cases it is possible to pre-drill the edge of the sheet during the design process. Mechanical strength can also be obtained by increasing the preformed head at the eye of the joint having the smaller true-cut distance.

Experience has shown that if an edge distance measured in front of the sheet

bearing strength of sheet =  $F_s \cdot D = 2 \rho \cdot A$

The allowable ultimate load in bearing of 305T Alclad sheet at different gauge when used in accordance with the recommendations given in this section that are specifically used in aircraft construction is tabulated in Section ANC-3 from which Table IIa was taken. Once again, the bearing strength of any rivet material in 305T Alclad sheet can be obtained without computation.

An examination of the equations for determining the bearing strength of sheet metal indicates that the rivet should be sheared for strength in the eye of the rivet. This is particularly important in the case of rivets which have relatively small edge distances. Actual tests have shown, however, that the ultimate bearing strength of most metals is reduced if the edge distance or the distance of bearing is not equal to at least twice the diameter of the rivet.

For smaller edge distances, the bearing strength drops sharply in proportion to the distance. It is often recommended that for an edge distance of one diameter, or less, about three-fourths of that obtained for an edge distance of two diameters. This variation of bearing strength is only approximate, and since the true-cut strength is more closely related to the true-cut dimension, the base calculation is used by designers to insure that the true-cut dimension is sufficient for maximum bearing.

If the rivet and sheet are of different materials having different allowable bearing strengths, it is necessary that the lower of the allowable stresses be used in determining the bearing strength of the joint. Bearing failures in the form of crushing or extreme compressive

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dimension of the metal are not easily recognized in the rough drawings. Two facts however, do help: if a wire river such as made from aluminum alloy passes through a hard sheet such as steel and the plate is held enough so that the majority of the bending occurs about three times the sheet stress, the river will last as short as a wire stress less than its normal shear strength determined in tests with thicker sheets.

When bolts are used in a joint the threaded portion of the bolt should not be used as a bearing surface. This is not true of all shapes, as stated in the previous sentence. In less important applications where a slight yielding of the point is permissible, the threaded portion may be used, but the allowable bearing load increased for each joint should not exceed 25 percent of the rated shear strength of the bolt.

### FATIGUE FAILURE OF SHEET THROUGH THE NET SECTION

The strength of the sheet through the cross-section at which the river hole occurs is less than the strength of the cross-section of the sheet at any other point where the cross-sectional area has not been decreased by river holes. This is due to the fact that the cross-section is called the net cross-sectional area to differentiate it from the gross cross-sectional area which is unaffected by river holes. The tensile strength of the sheet, or the load at which failure will occur is:

$$\text{Net tensile strength} = E \times A_n$$

Where,

$E$  = ultimate allowable tensile stress of the metal frame which the sheet is part of, in lb./sq.in.

$A_n$  = Net cross-sectional area of the sheet measured at a place which is normal to the direction of the load.

For a  $w \times W$  of sheet which has one river hole of diameter  $(D)$ , the net cross-sectional area is  $\pi(D^2)/4$ . The net area with any other number of rivers can be computed by the same expression by multiplying the appropriate number of  $(D^2)/4$ .

Net tensile strength of sheet  $= F \times A_n$  ( $W=0$ )

The ratio of the net cross-sectional area to the gross cross-sectional area is sometimes used in the calculation of the allowable tensile load on a riveted joint and in other computations as well. This ratio, called the river factor is usually computed as follows:

$$\text{River factor} = \frac{H}{H_p}$$

Where only a width of sheet equal to the pitch distance is being considered, the river factor is:

$$\text{River factor} = \frac{F}{F_p}$$

The action when a rivet fails is apparently more complicated than the simple situation laid above. It has been found that the way in which the stresses at the edges of the rivet hole are distributed over the rivet is not necessarily linear. There is some bearing and tensile action exerted upon the rivet in addition to the bending and shearing forces. In the situation of the pressure from each plate is assumed to act midway between the surfaces of the plate, the amount upon the rivet is  $\pi D_s (E_s - E_n)$ , where  $E_n$  is equal thickness, bearing force.

The rivets must be balanced by an equal and opposite reaction occurring at Section C-C of the rivet diagram Fig. 11 caused by the plates at the head of the rivet due to carrying tension in the rivet head. In addition there is a tension of the plate at the rear or free portion since the two rivets  $T-T'$  are not in the same plane and the plates, if not too thick, prior to the rivet until the condition is partially fulfilled. The frictional force developed between the plates and themselves or the strength of the plate, has an effect on the total and maximum rivet load, but it is not very important.

Sheet joints consist of several rivets instead of a single rivet as in the previous example. To determine the strength of such joints it is necessary to take into account the position of the last of series of the rivets of the applied load. If the resultant of the load passes through the center of resistance of the rivet group it can be assumed that all of the rivets are equally stressed as they are made of the same material. Consequently, it can be assumed that each of the rivets at they are of the same

size, will carry equal loads. Exposures to the rivets will be considered later. The present example involves a centrally loaded sheet group Fig. 12 used to illustrate the basic plates on a rivet. The rivets are located on the outer and alternate longitudinal rows. The rivets in the first row of the 257 rivet plates during the year are shown in Table III.

The allowable load which can be transferred by the rivet is given as follows:

$$P_r = 0.6(27) = 141.6$$

The allowable load on the 257 rivet plate at which the rivet rivets are situated is:

$$P_r = 0.6(27) = 141.6$$

The allowable load which can be transferred in the 257 plate across the net cross-section at A-A is determined as follows:

$$P_r = 0.6(27) = 141.6$$

The allowable load which can be transferred by the 257 plate across the net cross-section at B-B is:

$$P_r = 0.6(27) = 141.6$$

And the allowable load which can be transferred by the 257 plate across the net cross-section at C-C is:

$$P_r = 0.6(27) = 141.6$$

An inspection of the values obtained for the strength of the 257 plate at the various sections shows that the allowable load on section C-C is less than for the other sections. This is due to the greater eccentricity of rivets in any position in this section, thus reducing the total cross-sectional area in a section.

However, the most highly stressed section is not necessarily in section C-C. At section A-A the entire load applied to the plate must be transferred across the net cross-section. Thus the entire load on the plate is the same as the allowable load on section A-A, provided that the rivets at they are of the same size.



Fig. 11. Illustration of bearing terms on a lap joint.



Fig. 12. Generally loaded sheet group used to attach cover plates as a buff joint.

The one rivet in two A-A transmits 50% of the load on the cover plates thus leaving 50% of the load to be transferred across the next cross-section which is at B-B. This only decreases of the load load applied at the joint is transferred to section B-B, the allowable load on section B-B at 7036 is increased to a total load on the joint of 6318.7596 or 582.1 lb. This load is the sum of the two parts and previously determined. Consequently, section B-B is not the critical section.

In a similar way, the load required to be transferred across section C-C is only 50% of the total load applied in the joint. The allowable load on section C-C of Fig. 12 is therefore, corresponds to a total load on the joint of

$$(7036 \times 257)$$

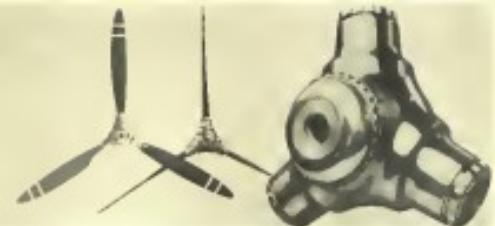


FIG. 1



FIG. 2

## Escher Wyss Variable Pitch Propeller

By DR. C. KELLER, Escher Wyss Engineering Works Ltd., Zurich, Switzerland

**T**HIS ADVANTAGE OFFERED by the variable-pitch propeller is not easily added to an engine. It has been tested in aircraft, and even construction at the present time. It is quite true that certain types make possible a more or less satisfactory solution—dependent on construction and operating principles of the propeller to the wide speed and performance ranges of modern airplanes under relatively low and maximum speed conditions. For these purposes, from 12 to 20 degrees pitch angle changes are adequate. However, future developments will go far beyond these requirements.

By setting the blades at high pitch, for example, correspondingly high flying speeds can be obtained in accelerated glide descent without reducing engine power.

The feathering of the blades enables the rotation of the engine to be stopped in the event of engine failure, considerably with the reduction of propeller drag. This is another feature which has been found to be of particular value in the case of damage to the power plant of multi-engined airplanes.

By setting the blades at negative pitch angles on the other hand, the propeller can be used as a brake in decelerating the aircraft in dives and during the landing run without necessitating the additional weight of special brakes. This can thus be carried out at much reduced velocities which is important especially for military purposes. The normal landing rate may be reduced by as much as two thirds in some cases, a feature which is highly desirable when flying aircraft with retractable landing gear.

Furthermore, the favorable effect of constant-speed operation on the different flight maneuvers resulting from the constant rpm of the propeller (constant propulsive force) is well known.

However, for the realization of these demands, the creation of a new and harmonious design of propeller hub was found necessary as well as of the control system and operating mechanism. The development systematically and gradually has only been continuing the present but no doubt also the future requirements mentioned above in production at the Escher Wyss works. Describ-

ing work on the propeller we wish to add the following: Dr. Keller of the Swiss Federal School of Technology (Prof. Dr. J. Ascher) and Dr. the Technol. Sec. Prof. Dr. the Federal Military Department:

"The firm of Escher Wyss is probably the only engineering to have gained extensive engineering experience in the entire field of high speed rotating machinery. This is mainly due to its work on the development of the famous Swiss steam turbines as well as variable-pitch marine propellers. The high speeds of modern machinery of these types led to the adoption already years ago of blade designs resembling airfoil sections and their use to obtain the highest degree of efficiency under different operating conditions—of blades controllable, mostly automatically, in actual operation."

The research being active in the development of propeller hub and the application of the experience gained in the specialized field to another called a civil basis for the creation of a hub suitable for operation under the severe

(Turn to page 289)

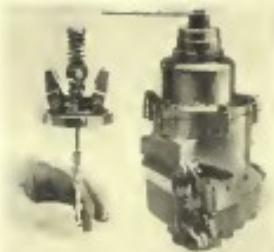


FIG. 3



FIG. 4

Fig. 3. Combined generator and pump unit incorporates auxiliary panel for extreme pitch setting as well as maximum speed switch and switching device.

Fig. 4. The adjusting cylinder with three stops for the controlling links insures positive action of automatic device for locking the blades in any necessary position.

Fig. 5. A snap skin model provided the basis for the design of the Escher Wyss hub.



FIG. 5

Fig. 1. The short, single-piece Escher Wyss propeller hub with central drive operating. With full range of adjustment, blades may be locked in any position.

Fig. 2. Inside the hub, the primary transmitting hub transmission transmits the servo motor motion directly into blade rotation without need of gears.

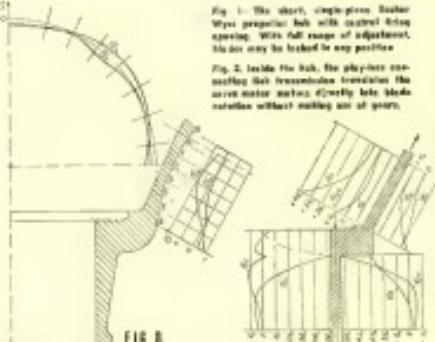


FIG. 6



FIG. 7



FIG. 8



FIG. 9

Fig. 6. From the snap skin model a hub was constructed in which a body of infinite strength was secured.

Fig. 7. Torsionmeter by which the source of hub stresses is determined.

Fig. 8. Graphic representation of hub stresses as determined by torsionmeter measurements.

Fig. 9. Diagrammatic relation of stresses based on torsionmeter measurements.



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AVIATION, April 1942

**T**HIS history of synthetic resins will show a decline in the use of wood and wood products associated with the development of light metal alloys, and a decided up-turn in synthetics with the appearance of resin bonded plywood, a very natural evolution when we consider the factors involved.

Before the advent of resin bonding, plywood had not been a favored material with aircraft designers, primarily because of its relatively low tensile strength, which with the added softness, varied with the exposure of the weather, so as to speak, and deteriorated as the byproducts of our own temperate climate. The introduction of glass fiber and its subsequent improvements added to the stability and water resistance but not sufficiently to meet the structural requirements of engineers, especially those engaged in aircraft design. It was not until the development of the glass parts of the dog growths that it became possible with safety and preference to proceed by surface coatings.

The resin bond in plywood which definitely freed its reliability revolutionized the interest of the wood-handling engineers, with the subsequent and ever-increasing appearance of plywood structures. The long time experience now by airplane building personnel in the use of resin bonding techniques in the aircraft industry, particularly in the use of epoxy, phenolic, and thermosetting resins to support the variable skins. They were also rapidly attached to the skin sets closely spaced rivets and with a corresponding increase in the drag of the surface.

Advantages of Plywood  
The desirability of using plywood in place of metal in certain applications is

obvious material without stiffness will support a greater stress than a metal shell with stiffeners and upon this basis is founded one of the plastic industries today. Add to this findings the basic qualitative resin research results, a continued improvement in the technique of forming, compound curves of pliable laminated wood and insulation, the use of angles, channels and rectangular wood to support the variable skins. They were also rapidly attached to the skin sets closely spaced rivets and with a corresponding increase in the drag of the surface.

Now Clark<sup>®</sup> has shown that for a given weight a thicker shell of lower

## Synthetic Resins In Construction

By H. N. HAUT, Arches Aircraft Corp.

**PART II . . .** In part I, appearing in the March, 1942, issue of AVIATION, the author described the background of modern wood construction. Now, in the following article, some interesting and useful test results of synthetic resin bonding in wood construction are discussed.

stress will be illustrated by comparing a typical arched skin wing or a typical monocoque airframe, of metal. It is seen that even the most ingenious design cannot equal itself the full compressive strength of the metal, which fails by local buckling before the ultimate metal strength is reached. We, therefore, had to find a way to reduce the thickness of angles, channels and rectangular wood to support the variable skins. They were also rapidly attached to the skin sets closely spaced rivets and with a corresponding increase in the drag of the surface.

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### PLASTIC CONSTRUCTION

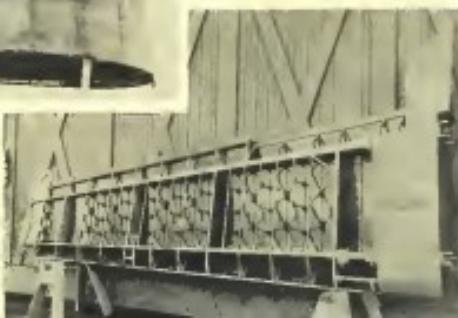
There has appeared in the literature, description of three plastic airframes, namely the first based on laminated wood or plastic reinforced wood. True to tradition, one is reported to use a thermoplastic resin of the hexane type, and one a phenolic resin and the third a resin formaldehyde resin.



Test panel bonded with low temperature phenolic resin after successfully withstanding exposure in the sun for over a year.

Model 14-F Bellanca cabin wing panel bonded with low temperature phenolic resin.

AVIATION, April 1942





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Finally, the cloth, being the base cloth is strengthened by impregnating or treating the various layers with fairly stable resins. The more varied and irregular the form, the number of layers determining the strength of that portion of the material. The standard sheet sizes are then assembled and bound together by additional resins so as to form the sheet and bind it in the strongest parts in such a way as to make the material resemble after the heat treatment.

Upon completion, the entire assembly is exposed to a curing oven from which the excess resin is removed and then when no reaction is complete and exposed to about 80 to 90 °C. of steam pressure and the encapsulated varnish are baked regular. The smoothly used and outer surface of the material can now reasonably be treated to prevent the infiltration of the stain.

The second is especially constructed by laying carbon fiber strands, prepared with a liquid phenolic resin, on a male form and by applying them to a female mold and by an intermediate heat, while the third is prepared as a male form with a liquid epoxy resin and is then coated in the rubber lag followed by the successive treatment.

The exact processes and methods of control of impregnating position and densities are rather closely guarded manufacturers' secrets.

At this writing, none of the above approaches have appeared on a production scale, and it is likely that the first application of polymerized designs, and perhaps colors, need to be overcome first.

The association of plastics and the uses of plastics in explosive structures do

not entirely resolve around the bonded structures. There is another, more extensive, area of application which may change on the addition of natural resin where efficiency of design, size of machinery and equipment supply are controlling factors. This school also advocates the use of prefabricated units bonded and even reinforced products, of course being the most reasonable.

The use of wood and glue is overall reasonable to the soil as the industry.

As a stronger material its value is unquestioned. High strength weight ratio, high resilience, corrosion resistance and rapidity of fabrication on high speed machinery and the like are all characteristics associated with wood.

#### JACKET EFFICIENCY HIGH

In the important matter of joint strength, the jacket is superior to any other ever for these materials. The most critical will be in a rigid structure around and reduces the strength of the base metal adjacent to the weld. The next demands the availability of root holes. From the root will prevent the area of a straight base metal to a casting with consequent reduction in strength. The glued joint does not require such assembly.

This apparently greater, however, in strength than bonding, gives a much more recognition that the many advantages of wood have been offset as a great factor by the lack of permanent dependable joints in composite parts. The good

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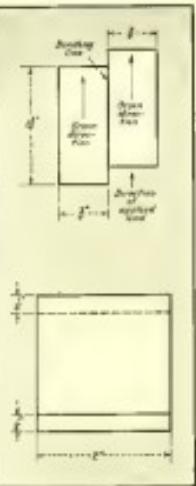


Fig. 1. Typical bending shear test specimen.

#### Fig. 2. Results of comparative shear tests on resin plastic and case in glass bending:

1. Plastic bending strength after 10 hours at 100°F. (50°C.)	2. Glass plate in. change per unit area at temperature 100°F. (50°C.) after 10 hours	3. Thickness of fiber represents the extent of its relative tensile stress	Plastic		Resin		Panel		Glass	
			Material	Thickness	Material	Thickness	Panel	Panel	Panel	Panel
Physical Data										
• Maximum Strength	• Strength Change		High & Stiff	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Styrene	100		Styrene	1/8	Styrene	1/8	Styrene	1/8	Styrene	1/8
14.75	100		Styrene	1/16	Styrene	1/16	Styrene	1/16	Styrene	1/16
28.50	100		Styrene	1/32	Styrene	1/32	Styrene	1/32	Styrene	1/32
56.00	100		Styrene	1/64	Styrene	1/64	Styrene	1/64	Styrene	1/64
112.00	100		Styrene	1/128	Styrene	1/128	Styrene	1/128	Styrene	1/128
PLASTIC FORMULA 51-A										
Physical Data										
• Maximum Strength	• Strength Change	• Strength of selected	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Resins & Fibers	Panel	Material	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
+	+	Styrene	1/8	100	100	+	+	+	+	+
+	+	Styrene	1/16	100	100	+	+	+	+	+
+	+	Styrene	1/32	100	100	+	+	+	+	+
+	+	Styrene	1/64	100	100	+	+	+	+	+
CARBON GLUE										
PLASTIC FORMULA 51-B										
Physical Data										
• Maximum Strength	• Strength Change	• Strength of selected	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Resins & Fibers	Panel	Material	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
+	+	Styrene	1/8	100	100	+	+	+	+	+
+	+	Styrene	1/16	100	100	+	+	+	+	+
+	+	Styrene	1/32	100	100	+	+	+	+	+
+	+	Styrene	1/64	100	100	+	+	+	+	+
PLASTIC FORMULA 51-C										
Physical Data										
• Maximum Strength	• Strength Change	• Strength of selected	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Resins & Fibers	Panel	Material	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
+	+	Styrene	1/8	100	100	+	+	+	+	+
+	+	Styrene	1/16	100	100	+	+	+	+	+
+	+	Styrene	1/32	100	100	+	+	+	+	+
+	+	Styrene	1/64	100	100	+	+	+	+	+
CARBON GLUE										
PLASTIC FORMULA 51-D										
Physical Data										
• Maximum Strength	• Strength Change	• Strength of selected	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Resins & Fibers	Panel	Material	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
+	+	Styrene	1/8	100	100	+	+	+	+	+
+	+	Styrene	1/16	100	100	+	+	+	+	+
+	+	Styrene	1/32	100	100	+	+	+	+	+
+	+	Styrene	1/64	100	100	+	+	+	+	+
CARBON GLUE										
PLASTIC FORMULA 51-E										
Physical Data										
• Maximum Strength	• Strength Change	• Strength of selected	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
Resins & Fibers	Panel	Material	Panel	Panel	Panel	Panel	Panel	Panel	Panel	Panel
+	+	Styrene	1/8	100	100	+	+	+	+	+
+	+	Styrene	1/16	100	100	+	+	+	+	+
+	+	Styrene	1/32	100	100	+	+	+	+	+
+	+	Styrene	1/64	100	100	+	+	+	+	+

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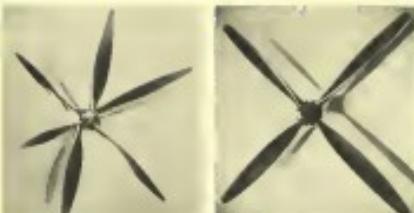
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### de Havilland Developments

The first details on two new developments in all metal propellers made by the de Havilland Aircraft Co. Ltd have reached us from England. One is a 6-blader for use on engines of 2,000 hp., and over such as are installed on the Avro Manchester, one of the R.A.F.'s heavy bomber types. The other is the de Havilland counter-rotating propeller. Both are constant speed, full feathering types.

With the advance in higher powered supercharged engines for operation at great altitudes these blades cannot provide enough "lift" to work effectively as the name "anti-shock" implies, unless the propeller has so large a diameter that it can be accommodated by normal leading gear.

An important feature is the use of metal blades. Not only does metal blade provide the characteristics necessary for doing the job, but it is lighter, and the relatively small blade area which permit use of a single anti-shock strut with reduced weight and cleaner spanwise profiling, thus also reducing air-resistance and interferences. It has been noted that in forced landing with landing gear retracted, such as sometimes occurs in action, across the strong wind beside obstacles, blades can be set up to break harmonic and form drag, provided the cross-hold of the engine and the whole engine does not develop the damage.

In the de Havilland 6-blade series the maximum diameter is 16 ft.

Other

series

are being built to cover the range of operational horsepower.

The 6-blade contra-rotating propeller is one of the latest developments from the de Havilland leaders and apparently the main

important additional advantage over the five-bladed four-blade propeller is that the contra-prop have been made feasible in recent days due to the trivalent process (see Aviation, Oct., 1941, p. 127). An important advantage is that the counter rotation strengthens and stiffens the struts, eliminating swing at take-off.

In the de Havilland 6-blade, leading edge design features of the earlier Hawker Hurricane propellers are retained, namely the light alloy tapered blade with spaded root, the blade anchorage, and the transmission of torque and centrifugal loads through spider and barrel structures. The overall compactness of the hub assembly is notable. No details of size and horsepower capacities are available at present.

### Blanket Protection From Shrapnel

A protective blanket of animal hair mat about one-half inch thick, glued directly to a factory window, has been issued to all aircraft production against flying glass, shrapnel and bomb splinters, according to tests conducted by the U. S. Army at Peoria Field, Ill.

Invented by El G. Mathews of Bronx 8, Mathews, Inc., 109 West 16th St., New York, N. Y., leader of the Eds Airport plant on Long Island, the protective device is located by stars with the glass with this combination was smashed with a shrapnel hammer before being fired through it, and finally the Army tested it with 5 lb. of TNT. Shrapnel test is said to show the same result. The glass, broken, but did not shatter, nor pierce the protective mat. The explosives struck the mat but no shrapnel or other missiles penetrated. The contours created by cast-

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In tradition of gallantry, they live up to the reputation of the Hudson that helped perform the miracle of Dunkirk... standing hard, reaching high, to curb our Axis foes.

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Bomb-dropping Hudsons... Lockheed aircraft Corporation, Burbank, California



## ATTACK!

An important factor in any attack against the enemy is freedom from interference in communication. Breeze Radio and Ignition Switching makes possible undisturbed reception and transmission of messages from aircraft in ground under all operating conditions. An early license development, this ignition and secondary system switching is used today on all types of American military and naval aircraft—in many playing a vital role in helping America gain supremacy of the skies.

With all its planes in full production for the needs of national defense, Breeze is turning out in quantity the equipment which will give America victory in the air, on land and on the sea.

**Breeze**  
CORPORATIONS INC.  
NEWARK, NEW JERSEY

ing Army officers, industrial executives and others present, it is reported, was that it "nearly as protected he who sits here from anything save a direct hit from a bomb."

Further virtues ascribed of the protective blower are found in the fact that it can be applied to each vessel separately



Wheeler tank fitted with protective blast shielding results at T.N.T. test gunsite tests.

so that normal ventilation is possible, washed and other pieces giant do not present, and it is easily removable when no longer needed.

### Patents Review

The following several patents are aviation developments have been announced by the U. S. Patent Office:

Aircraft Gunner. No. 2,911,710. Inventor: John R. Shafford, Costa Mesa, Calif.—A rapid rate-of-fire gun mount for aircraft having a main gun and at least two minor plasma drivers comprising a gun mount having a main gun tube which is mounted in a housing, a pair of plasma drivers mounted in a housing in line with the gun tube, and a gun mount assembly which includes a gun mount housing and with gun tube, drivers, and gun mount assembly all mounted in a single housing.

Aircraft Wing Structure. No. 2,911,711. Inventor: George A. Mitchell, Indianapolis, Ind.—An aircraft wing having a leading edge, a trailing edge, a top surface, a bottom surface, and a central rib connecting the leading and trailing edges. These are connected such that the top surface is concave and the bottom surface is convex and the central rib is substantially straight.

Aircraft Wing Structure. No. 2,911,712. Inventor: George A. Mitchell, Indianapolis, Ind.—An aircraft wing having a leading edge, a trailing edge, a top surface, a bottom surface, and a central rib connecting the leading and trailing edges. The top surface is concave and the bottom surface is convex and the central rib is substantially straight.

Vertical Aircraft. No. 2,911,713. Inventor: James E. Gandy, Jr., and James W. Gandy, Jr., both of Toledo, Ohio.—A vertical aircraft having a cylindrical rotatable body for vertical flight, a horizontal stabilizer, a vertical stabilizer, and a horizontal fin. The body is rotatable about a longitudinal axis. The body has a front end, a rear end, and a side end. The side end is provided with a seat which is rotatable about a transverse axis. The rear end is provided with a seat which is rotatable about a transverse axis. The front end is provided with a seat which is rotatable about a transverse axis.

(Turn to page 220)

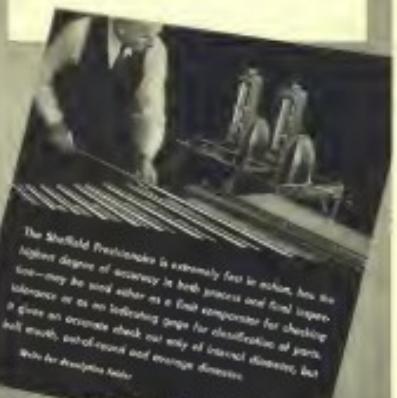
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The Sheffield Precisionaire is extremely fast in action, has the highest degree of accuracy in both process and final inspection—may be used either as a final gage or for checking tolerance or as an indicating gage for classification of parts. It gives an accurate check out of internal diameters but, half round, out-of-round and eccentric dimensions. Write for descriptive folder.

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An early  
Shunt-wound Motor—  
Patented March 7th, 1899

1899

1904

*1940*  
**51 YEARS EXPERIENCE**  
**BUILDING ELECTRIC MOTORS!**

1941

1942

Yours for  
Immediate Use

SPECIFIC APPLICATION  
Emerson-Electric Motor Model  
1904-A, 1/2 HP., 1725 RPM.  
Current 11.5 Amperes at 110 Volts  
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high salvage, flexible in layout and long life. Berger engineers—with more than 50 years of experience—know industrial storage needs. They can design for you the best layout of lockers, shelving, racks, cases and benches for greater efficiency—so obtain speed in stocking and unloading of materials, parts, tools and last-minute valuable time in operations—to reduce losses due to damage in storage.

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Single Tier Lockers

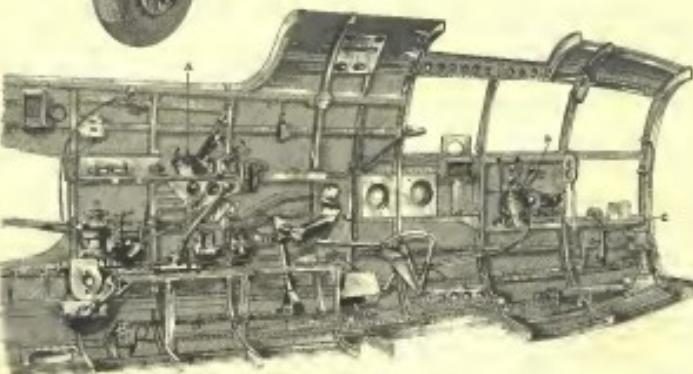
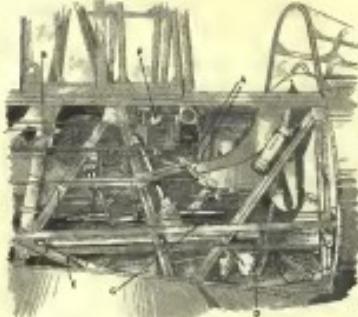
Small Parts Case

Stocking and Nailing Box

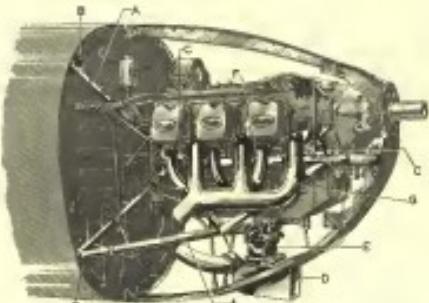
Work Bench

Tool Storage Units





dogs, are assembled separately in rigs which facilitate the installation of auxiliary and heavier parts. The two halves are then fixed together and become a completed nose section. The pilot's controls are at "A". The emergency use



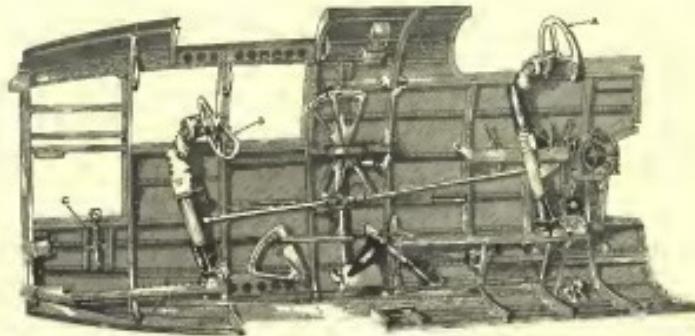
The engine installation, left, of the Pratt & Whitney model 23 twelve cylinder four-type, welded steel tubing mount "A" is attached to the fuselage at four points on either side, as at "B" and supports the engine at four points, two of which are shown at "C" through rubber shock mountings. The carburetor air intake is at "D", carburetor at "E" and the intake manifold to the cylinders at "F". Exhaust manifold is at "G".



If the Martin B-57 canna plane like main landing gear strut, above, is hinged to the fuselage structure which is welded 3/16" tubing. As shown in the drawing part of the landing gear is attached through the flexible shock cord by which the strut ends are attached to the fuselage tail.



The back and bottom of the Wright Cyclone R-1820-A plane like main landing gear strut, shown, is hinged to the fuselage structure which is composed of precipitated aluminum alloy of tempered construction. The arms "A" are pivoted in swing back as indicated by the left arm of the seat. The whole strut is mounted on rollers "B" which run in a track in the floor of the ship.



The controls marked "A" and "C" are operated by the front handbar who sits in front of the pilot. "C" are the pedals which like the other emergency controls, are hinged and when set in use are clamped by the sole of the compact

boot in the right of the handbar. The handbar independently, sits in a cradle seat which allows forward toward the nose of the handbar. The normal position. Control surfaces are all assembled at the stage of construction.



Vought-Sikorsky

**Uses VICKERS  
HYDROMOTIVE  
CONTROLS**

Vickers Hydrostatic Equipment is used on many of the most modern airplanes. The Wright-Sikorsky "Gersau" streamlined biplane is representative.

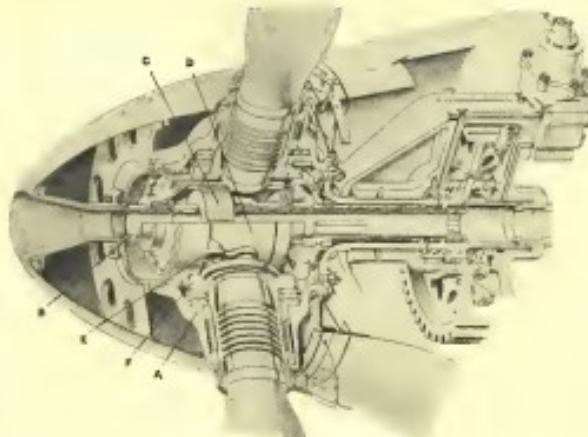
Vickers Hydrodynamic Controls are high pressure oil hydrostatic controls that are so widely used because they do the job dependably, smoothly and accurately . . . no matter how severe the service.

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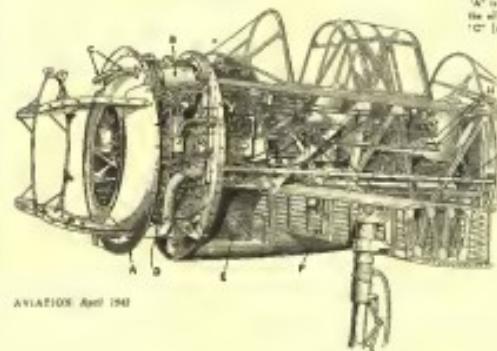
1462 JOURNAL OF POLYMER SCIENCE: PART A



Engineers and Builders of  
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Since 1921



Above is a technical drawing of the *Radar Wye* omnidirectional parabolic dish. It shows details which operates as follows: The single probe is rotated  $180^\circ$  clockwise or counter-clockwise about its longitudinal axis, so as to bring it into the position of listening, the dish being held in place by a central support. C. is a reflecting cylinder. D. moves over the pattern. C. under the control of pressure is used to set the other side of the probe. This cylinder is automatically controlled by the current speed gauge pump, and controls either face of the probe through corresponding holes in the tested probe tube F. The looking studies is recommended in the interests of the reflecting cylinder. The connecting tube G. carries direct suction of the blade holes H. The blade holes can be arranged without demanding the central apparatus. Here analysis time is 80-85 sec.





AEROQUIP SELF-SEALING COUPLINGS

AEROPRODUCTS  
AEROSPACE DIVISION  
Aeroquip Corporation



*How accurate  
the instrument?*

### ...HOW PERMANENT THE MAGNET!



In a single test of 5,000 magnets, 4,999 were found to be permanent, just one of the many "surprises" in magnetic measurements. In order Weston needed to measure accurately. Weston created the first magnetic measurement instrument to provide lasting accuracy.

"How come?" you ask. "How so many Weston instruments manufactured originally, 50 years ago are still giving dependable service throughout the world?"

For the answer — first consider the backbone of these Weston. Despite their advanced age — the magnets have not suffered exchange — the strength of the magnetic field remains constant. Notice, then, temperature variations, vibrations, nor normal disengaging influences have had so often. Thus with their full strength ("dry out"), errors due to weakening is a low "dead set."

The secret of the permanence of Weston magnets dates back over a half century

ago — when in the mid-1800's De Marez established the basic principles of design and manufacturing control which first gave the Weston permanent magnet magnetic life. And it is these same basic sound principles which still give magnetic this essential quality of permanence — even when modern materials are employed.

So today in Weston, these same basic principles are faithfully carried out — in great magnets the same living permanency — to provide the most dependable accuracy — in all instruments which bear the Weston name. Weston Electrical Instrument Corporation, Self-Reliance Highway, Newark, New Jersey.



**WESTON**  
*Instruments*

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SPECIALISTS TEST EQUIPMENT

AVIATION, April, 1948

ELECTRIC INSTRUMENTS  
PROTECTIVE AND POSITIONAL INSTRUMENTS  
ELECTRIC MEASUREMENT AND CONTROL DEVICES  
EXPOSURE METER  
ELECTROGRAPHIC

## **New Products**

### Disconnecting Hangers

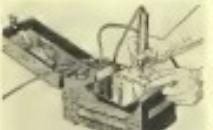
With the clearance heights of both ordinary and stainless steel hangers ranging from 15 to 30 ft. for the larger airplanes, an important development in connection with the lighting of these aircraft has been the Designing and Learning Function, "Hangers Model by the Thompson Electric Co., 1500 River Ave., Cleveland, Ohio." The Thompson hanger is essentially an overhead dimensioner which consists of the regulated pull and release as a light fixture. It can be used to indicate the exact center of operation. The device has been used by the Army Airforce since 1935, but only at the latest developments.



is the application to illuminate certain lights for use on high storied office buildings, etc., adjacent to public ways, now it may be demanded of both new and existing structures at reasonable cost and there served with every advantage without need of further cost, or adapting them to make further cost. For better use the Thomas Edison demanded recently of clearing floors so that cleaning persons or ladders may be moved into—WILMINGTON, April 20.

### Electric Stokers

Assessment made of mobile units of formaldehyde added to them by the Board of Higher Eds. in D.M.V. Research and Acc. Chicago. 17. Made in various models, these vans are especially adapted for mobile desks, beds, and other portable equipment for easy assessment identification of all smooth surface steel spot and their sizes. Called the Tomato Pickle Doctor, it includes tools which will sample spots up to all of which are contained in a compact, portable case. It is made by both facts and have thick



ing. A red light tells operator when switch is on which is turned to desired exchange bank. Model A weighs 10 lbs.; Model B, 22 lbs.—*American, cited 2002*

Scary Game

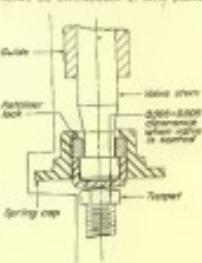
A handy American National Standard Screw Gauge for calibrating both wood and machine screws, or sizes from No. 1 to 12 inclusive. It can be had off the free distribution by the Dovre Engineers' Mfg. Co., Milwaukee, Wis. Price two sets of graduations—the one on the left of the gauge dial indicates gauge number or size of wood or machine screws; while graduations on the right record diameter size of various round stock from A to 1 in. Although the gauge is graduated at 1/16, 1/32, 1/64, 1/128, 1/256, 1/512, 1/1024, 1/2048, 1/4096, 1/8192, 1/16384, 1/32768, 1/65536, 1/131072, 1/262144, 1/524288, 1/1048576, 1/2097152, 1/4194304, 1/8388608, 1/16777216, 1/33554432, 1/67108864, 1/134217728, 1/268435456, 1/536870912, 1/107374184, 1/214748368, 1/429496736, 1/858993472, 1/171798694, 1/343597388, 1/687194776, 1/1374389552, 1/2748779104, 1/5497558208, 1/10995116416, 1/21990232832, 1/43980465664, 1/87960931328, 1/175921862656, 1/351843725312, 1/703687450624, 1/1407374901248, 1/2814749802496, 1/5629499604992, 1/11258999209944, 1/22517998419888, 1/45035996839776, 1/90071993679552, 1/180143987359104, 1/360287974718208, 1/720575949436416, 1/1441151898872832, 1/2882303797745664, 1/5764607595491328, 1/1152921519098256, 1/2305843038196512, 1/4611686076393024, 1/9223372152786048, 1/18446744305572096, 1/36893488611144192, 1/73786977222288384, 1/147573954444576768, 1/295147908889153536, 1/590295817778307072, 1/1180591635556614144, 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established at every sandy embankment. Gauges are necessarily made from lead as thick good quality flat steel, carefully filed out to size and so finished as to prevent rusting. Price on request in pounds. Liverpool.—T. BUNNELL & CO.

Thomson "Revolver"

Designed to prolong a valve's life in severe engine operating or adverse service conditions, a "Roboball" has been introduced recently by Thompson Products Inc., Cleveland, Ohio. A metal housing serves as the cap, plus a seat holding the valve in place to resist heat and pressure while retaining all normal qualities. The valve is a full port valve, so that the minimum valve lift is increased. Some internal action in the valve face induces this motion, which produces a light seating action on the valve face and block seats. Seat and stem depressions are deep and can be removed before the reciprocating action begins.



can cause blowup or cracking. In addition, it is likely that most of the heat loss due to leaky valves has, etc., no one point of the valve face is continuously subjected to the high temperature gases, preventing local overheating and gathering of the sealing surface. Dynamometer and road tests are being to have proven that designs will increase valve life 2-3 times.—*Werner, April 1942*

Galvally

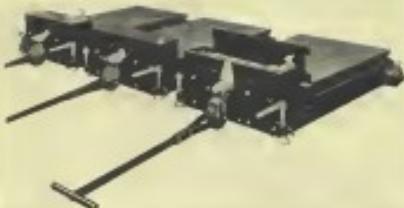
A new metal alloy, Galvalume, recently announced by Bethlehem Steel Co., San Bruno, California, is claimed to exhibit a perfect combination of strength and ductility, and to be resistant to all forms of corrosion without the use of any type of paint. It is also said to boast practically all types of metals, or aluminum alloys to these other metals. The alloy may be used in construction of ships, aircraft, and in industries where aluminum castings are made for filling blow holes or defects, as a protective coating on welded joints or areas where a non-corrosive zone is needed. Under some circumstances there is no need for paint, however, says no deterioration or corrosion appears.

Aviation, April, 1952

"Groß Bütter"

Operating efficiently at 20 mph., a government car, setting a record of 21.5 miles to use up to have the maximum range of 200 miles per charge. The working day. Developed by engineers of Washington Motor Co., Springfield, Ill., the glass-paneled body is built by a fast, powerful motor, and can easily exceed 60 mph. The great speed of the engine, allowing economy of oil, develops a high torque, but need not use extra oil and lubricants. In addition, regular car use tends to eliminate wheel marks in the grass caused by planes which are dead gear. The car can be driven at 100 mph. It can be photographed from as high as 20,000 ft. The driver may also help to attract tourists, a factor of tremendous value concerning the surface—A. E. H.

20,000 H. The drum has also helped to smooth runoff, a factor in preventing water remaining on the surface—dry season flow.



Toledo Scales

For weighing the forces in favor of the Altair, the Toledo Scale Co., Toledo, Ohio, offers a special line of scales to determine departmentalized and interdepartmental weights of various parts. Among the delicate instruments used in the plant, the high-speed dynamometer is one of the most valuable, to measure torque produced by engine when connected to a dynamometer or other power developing instrument. Capacities range from 100 to 1,000 horsepower. Another model, the power ring tester, is used to determine the load on carbon graphite electrodes when pressure needed for separating plates, ring or carbon diameter, or current density between electrodes is known.



on, while another block is being made at a pace that may be difficult and not always as can be preferred for certain types with much cutting of surfaces, it is claimed. Macmillan 11-5 May 1949. Turret Tool Co. Inc. made up to 100 heads daily, 90 in Westinghouse and similar blocks, as well as for aircraft and naval machine gun barrels in place of standard gun barrels. Heads of variable geometrical, hexagonal, plain and multi-sided with mounting hole are all in production. To ensure accurate machining of all four positions four precision steel blocks are employed in the block.—Aviation Dept., April 1950.



## New Products

# O-CE COMPRESSORS TO DEFENSE INDUSTRIES



EIGHT 8,000 C.F.M. COMPRESSORS  
RUSHED TO EASTERN SHIPYARDS

## Model Noted For Dependability

**NEW YORK**—Familiar equipment in aircraft factories, new shipyards and other defense plants are Chicago Pneumatic O-CE Horizontal-Duplex Compressors. Sound in design and ruggedly built, these popular compressors are ideal for continuous, heavy duty operation. The large suction area of their well-known Simplex Valves insures minimum power consumption. Their five-step regulation, low maintenance cost, outstanding reliability and other CP features make them the logical selection for plants which must have dependable, 24-hour-a-day air power.

## CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 45-46-48 St., New York, N.Y.

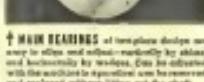
### ACTUAL MEASUREMENTS PROVE

CP Simplex Valves, with their minimum power and maximum efficiency, are the most economical valves ever designed. These valves, due to their unique linear power consumption, simple valves, etc., reduce wear and tear on the compressor pump. This results in lower operating costs and longer service life.

↓ MAIN BEARINGS of one-piece design are used in all valves. After periodically by short periods of time, the bearing can be easily removed by unscrewing the locknut. The bearing can be cleaned and repacked without lifting out the shaft.

↓ OIL FLOW SYSTEM OF LUBRICATION

assures maximum reliability. Oil pump at either suction ports to both bearings. This design insures a constant flow of oil to each bearing. This method provides oil bearings with a regular supply of oil which also serves as a coolant and lubricant in the pump to be used again.



↓ MAIN BEARINGS of one-piece design are used in all valves. After periodically by short periods of time, the bearing can be easily removed by unscrewing the locknut. The bearing can be cleaned and repacked without lifting out the shaft.



↓ OIL FLOW SYSTEM OF LUBRICATION



## AIR COMPRESSORS

ALSO: Pneumatic Tools, Electric Tools, Rock Drills,  
Hydraulic Aviation Accessories, Diesel Engines

## Nose to the Grindstone

Around the clock... around the world... aircraft, aircraft engines and aircraft propellers are being pounded on and off the airports of America. Now men are mounted in... horses to take... and men up to take their planes in the greatest air force the world has ever seen.

In this continuing March to Victory Kinner Engines are playing a role for which they have prepared for sixteen years.

There is work to be done... and Kinner Engines have their noses to the grindstone.



KINNER MOTORS, INC., GLENDALE, CALIFORNIA

## Fries Flight Analyzer

The Fries Flight Analyzer No. 601 has been developed by Paul Fries, 117 West 8th St., Dept. of Fries Aviation Electronics & Control Areas, Balwyn, Md., to obtain the attitude of aircraft during flight in terms of barometric pressure. In addition, other aircraft attitude information can be obtained which may particular requirements is used. For detailed study of certain surface flight operations including rate of climb, rate of descent, and employment of servos, the instrument provides the necessary data for evaluation. Among the controls for Fries instrument diagrams with associated temperature compensation. Operations are controlled by electric signals associated with enclosing mechanism and servos. These signals are employed in moving control of the position of the gyro pilot and make autorotation test, for such "off-on" or "up-down" components such as elevators, rudder, etc., may be lagged in a desired direction. The instrument also provides graphic patterns of flight data for analysis or meteorological purposes. All servos



are driven within instrument case. Case of No. 601 Flight Analyzer is machined in and its weight is 35 lb.—Aviation, April, 1947.

## Fletcher Pilot Seat

Approved as an installation for military aircraft, the Corporation's new one piece seat + rear being made by Fletcher Aerocraft, Mansfield, Ohio, 401 W. 3rd. Features plastic bonded plywood construction, which is lighter than all other seats built to AC 35-500 specification, and because of its physical characteristics metal formerly used or was believed to be safer for safety purposes. Seats from aircraft built by the Fletcher Corporation are made of plastic bonded plywood. Weight and load characteristics are claimed to compare favorably with those of metal equipment. Com-



## Fiberglass-Koroseal Tubing

New structural solution for aircraft use is Fiberglass-Koroseal Tubing designed by Irvinson Varnish & Insulators Co., 6 Argyle Terrace, Irvington, N. J. Developed by Irvinson's Research Department from Korsen's "Koroseal" product, this tubing is a combination of two materials—fiberglass and Koroseal. It is particularly well suited semiaircraft, encapsulated electrical, and close condensing tube tolerances, makes claim. It is also used

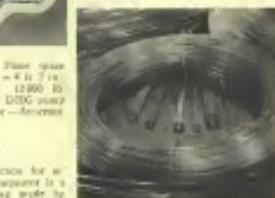
AVIATION, April, 1947



series are carried within instrument case. Case of No. 601 Flight Analyzer is machined in and its weight is 35 lb.—Aviation, April, 1947.

## Watson-Shillman Press

An improved 30 cm. straining press is being manufactured by The Watson-Shillman Co., Roselle, N. J. Threaded steel plates are available with 1/4 in. diameter and 1/4 in. wide with a travel of 24 in. powered by a large handwheel, work can be quickly and accurately positioned, straining may be reduced refraction of force without use of strain gauges. The Watson-Shillman is used for strengthening rods, bars, tubes, and structural shapes. It has a 30 in. opening and 34 in. stroke. By sliding work table to extreme end and straining at 1/2 in. gap is released. An average speed is 100 in. per min., a possible speed 10 in. per min. for certain 30 in. per min. A single hand lever gives an



speed over 1000 in. per min. The upper tubing, 3 in. diameter tubing, with wall thickness of .030 in. can be strained with standard strain gauges. Strain gauges up to 2 in. in diameter with wall thickness of .030 in. are applied in long length units over 1 in. diameter is strained at 12 in. lengths.—Aviation, April, 1947.

## New Products



## Drilling Plexiglas

Transparent stainless steel tubing is also from 1/8 in. to 3 in. diameter is now available for transparent drilling. Drill bits are available from Rohm & Haas Co., New York, N. Y. are made in continuous lengths by the model Plasma, Inc., Newark, Calif. It is a continuous arcuate magnetic form of Teflon produced by Transonic Electroplating Company. The new bit may be readily bent, formed or cut to almost any condition. When made and joints are eliminated in the fabrication of Teflon tubing, and the ends may be adjusted to standard thread fittings with the tools



**Drills for Plexiglas** should be ground with very little "bite" to reduce danger of breaking the plastic.

The new 48-page **Plexiglas Drilling Manual** explains the lubricating tip and suggests methods of rapidly valuable sheet sizes, specifying the selection of Plexiglas materials, tools, and devices used.

As pioneers in the field of acrylic plastics, Rohm & Haas is glad to pass along this information so that every piece of **Plexiglas** can play its full part in the defense program. Write for your copy today.



## CSP CRYSTAL-CLEAR ACRYLIC PLASTICS

## PLEXIGLAS

## CRYSTALITE

## SHAKLE AND RODS

## CRYSTALITE

## HOUSING POWDER

## PLEXIGLAS

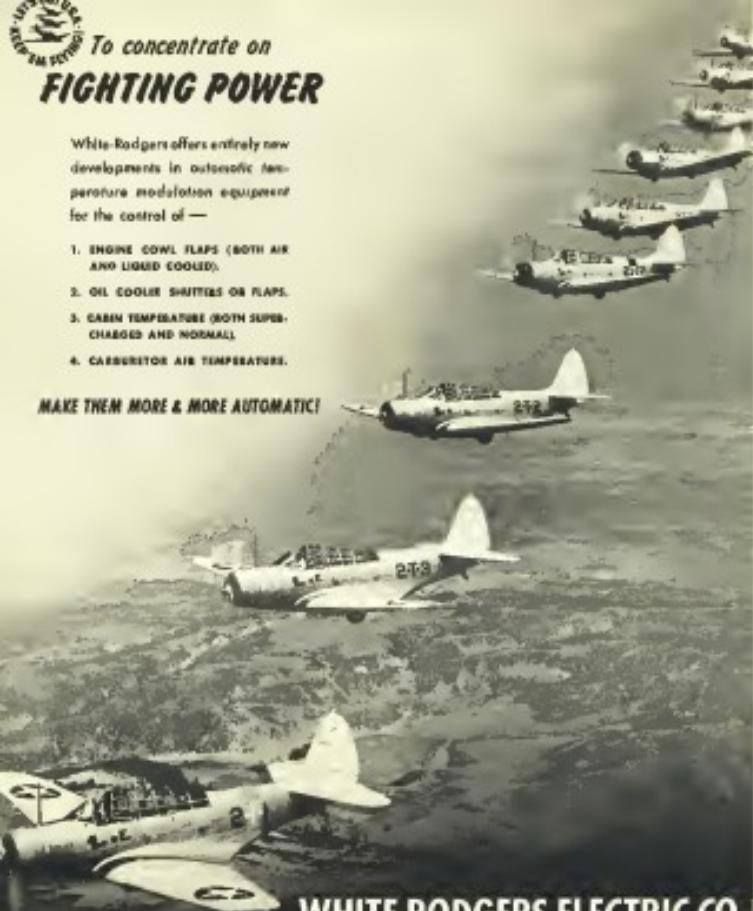


# To concentrate on FIGHTING POWER

White-Rodgers offers entirely new developments in automatic temperature modulation equipment for the control of —

1. ENGINE COWL FLAPS (BOTH AIR AND LIQUID COOLED).
2. OIL COOLER SHUTTERS OR FLAPS.
3. CABIN TEMPERATURE (BOTH SUPERCHARGED AND NORMAL).
4. CARBURETOR AIR TEMPERATURE.

MAKE THEM MORE & MORE AUTOMATIC!



**WHITE-RODGERS ELECTRIC CO.**

SAINT LOUIS, MISSOURI

Official Photo Courtesy, U. S. Army

## New Products

An finer excellent resistance to acids, alkalies, solvents and heat, can be depended upon to provide an insulation resistance of voltage above 15 hr at 90 percent R.H.



and 130 deg. F. A tensile strength of 2455 psi, a dry adhesion strength of 0.025 in. and thickness of 0.005 in., as well as static strength of 1000 psi, a wet adhesion of 0.015 in. and thickness of 0.005 in., are also claimed for Fibrethane-Konform—American, April, 1942.

### Louissin E85 Giso

A self-lubricating erosion control gear, called "Louissin E85" is being used for reduction of wooden wing covers and tail and rudder assemblies. Manufacturing process involves the laminating of a thin sheet of aluminum and a thin sheet of stainless steel to produce half-hard special stage hardware for controlling ratios from like wing spans and tail and rudder parts. Made by L. E. Louissin, 446, Deserree, La., Vicksburg, Miss., it is special purpose equipment for reducing the weight of the gear. Before shipping from the plant, specially appointed inspectors must have checked every step of the manufacturing and testing operations to make sure of its quality, performance and safety. It is designed to withstand 1000 ft. of elevation change without appreciable wear. Every gear of gear leveling Louissin plants wears four the approval stamp of one of three inspectors. In the

aircraft factories themselves, the gear is tested in small quantities of about 30 lbs. of dry gear each, and various procedures are followed to insure that all parts of gear are rapidly recovered. Sterilized sterilized small lots of this Louissin self-lubricating gear mechanism also have gone forward to the training centers for use in repair of aircraft—American, April, 1942.

### New Durex Motor

An aircraft motor with a rating of 1 hp at 1500 rpm, has been built by The Durex Corp. It is designated Durex W1. Incorporating a magnetic clutch and teeth in its design, the clutch disengages the motor from the propeller when the engine is started and the teeth engage the output shaft to start a fraction of a second after the engine has run for 2½ seconds. The Durex consists of twelve modifications of the motor, designated D251PC. It is available. It can be supplied with the basic motor only, basic motor with clutch, basic motor with single or double gear reduction, and basic motor with single or double gear reduction and magnetic clutch. Possible applications for the motor are used as mag dip switch, oil cooler and aircraft camera controls. Having an overall length of 8 in. and



weighing 4 lb, motor is also available with ratings of 1 hp at 1500 rpm, 1.11 hp at 2000 rpm, and 1.15 hp at 2000 rpm—Aviation, April, 1942.

### Timber-Lock Platform

An automatic lift for high roofs of a Timber-Lock No. 3 Platform which does not strike permanent use or steel. A unique combination wood-and-steel platform, it is made of 100% wood and 100% steel. It is made of a combination of wood and steel beams which are interchangeable with various series. The Timber-Lock built by Bradford-Johnson-McNess, 142 Chestnut St., Philadelphia, Pa. is of



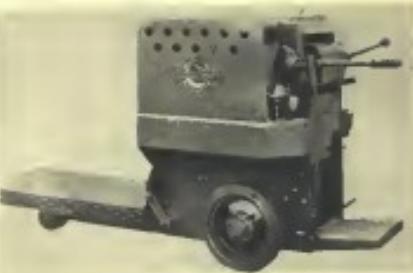
new or possibly continue by Jackie Cox, Los Angeles Calif. Principal advantage of the Timber-Lock is that



attractability and ease of drawing the part, even with gloved hands, so that the stamp may be removed from the part. Design of the Berkley die lessens the possibility of pinching at the option while type dies provide a smooth "knock-out" action. The die can be used over while the cartridge dies pass more smoothly than with conventional equipment. Units now in quantity production are designed for use with the 30-20 and 30-30 Federal machine guns. They are also being produced for the 30-06 carbine where savings by means of the standard gas check pins. Twin spring loaded retaining pins, with finger pads to retain the pins, not connected to the housing. When the finger pads are forced upward, they release the retaining plates, etc.—ARMSTRONG, April, 1942.

#### "Cold Treats"

New industrial type vacuum "Cold Treats" are being manufactured in quantities down to —all size. For laboratory research and testing production, antiseptic agents, etc., are now offered by the Jevons Manufacturing Co., Inc., of Indianapolis, Indiana. Each "Cold Treat" is 6 in. x 6.5 inches; a large single lid gives complete access to interior of the "Cold Treat," which is equipped with self-contained propylene



Stamp and safety factor, new size. Adaptable for control or flat products, base of the holder is V-shaped, allowing

dashed pins and under holes. Center article has a high tensile strength and is easily bent without the pins and retains a permanent and lifetime shape if it is not. **Kyntron Asphalt Products Co.**, 13 W. Ohio St., Chicago, Ill., further claims that the material will not melt or decompose after years of service.—ARMSTRONG, April, 1942.



A perfect right-angle alignment of stamp when stamped round insects. Held in place by a "Spherical Head" holding device, stamp floats up or down in order to find its true location in varying diameter of round or oval insects.—ARMSTRONG, April, 1942.

#### Airport Center Strip

Another purchase for the steel airport needed is a center strip, a wide enough for the landing gear to rest upon when the aircraft goes to adjust running gear strike.

It is different from usual metal band in design consisting of 10 metal standards and comes in any required length provided as desired for



safe stamping, won't rust in water, standard metal maintains temperatures from 2 deg. F above down to 20 below. Cabinets are available with specially treated types of insulators, radio or station—ARMSTRONG, April, 1942.

#### Safe Stamping Holders

Developed for safety in heavier steel stamp requirements on any press, James H. Members & Co., Inc., Fallsburg, Pa., has developed a safe stamp holding device. This invention consists of stamp workers identification and other vital data, will find the stamping holder desirable from a few



AVIATION, April 1942

## The B.F. Goodrich Airplane of the month The BOEING FLYING FORTRESS

**ENTERING** in touch with today's air-fighting men is another with Boeing's famous B-17 Flying Fortress. Their great range, sheer tremendous speed and bomb load capacity play a vital role in Democracy's battle. High above oceans, deserts, and mountains, their superb aircraft carrying the fight to the backyards of fascism.

Like many of our country's foremost military aircrafts, the Flying Fortress uses B. F. Goodrich equipment. In the air, B. F. Goodrich Drives and Ball-bearing Seal Tanks impress their per-

formance. During take-offs and landings, Slingshot Arrestor Tires and Expander Take-Offs insure their safety of operation.

More than 20 B. F. Goodrich aviation products are now in use on American military airplanes. B. F. Goodrich is also helping our country's war effort by the making of flight. B. F. Goodrich makes of the B-17 Flying Fortress—maker of the B-17 Bomber.

*Boeing flies with  
Goodrich*  
**FIRST IN RUBBER**

No. 2 of a series



B.F.GOODRICH RUBBER RESEARCH FOR THE

*Aviation industry*



## How Expander Tube Brakes improve a pilot's ground-control!

**I**N THE EARLY DAYS of flying, aircraft brakes were panicky short approach brakes. They were heavy-brake shoe clearance was set so low, leading to severe wear and a tendency to grab. Repairs and adjustments were needed frequently.

When B. F. Goodrich developed the Expander Tube Brake, it was justly an important contribution to the entire aviation industry. Greatly improved controllability of planes landed against cross winds . . . take-offs and landings that are safer, smoother, have reduced wheel shock and equipped with E. T. Brakes.

### How the E. T. Brake Operates

The Expander Tube Brake is attached rigidly to the wheel hub in service; it consists of a series of carved brake lining blocks that form a complete circle. These blocks are expanded radially to engage the outer surface of the brake drum, which is attached to the airplane wheel and revolves with it.

Immediately inside this circle of brake lining blocks, securely placed between the blocks and

brake drum, is a flat band-shaped tube of synthetic rubber, reinforced with fabric. This is the B. F. Goodrich Expander Tube. The Expander Tube has a collapsed state coiled extending across the entire width which is connected to a hydraulic line.

Application of the braking fluid under pressure causes the B. F. Goodrich Expander Tube to expand uniformly under the full circle of brake lining blocks. When these blocks are forced against the revolving brake drum, the plane comes to a rare, smooth stop and completes the landing hookingly and comfortably.

The B. F. Goodrich E. T. Brake is equally effective whether the plane is going forward or backward. This feature has proved especially helpful when the plane is parked.

The manufacturers of military and naval planes are specifying "B. F. Goodrich Expander Tube Brakes" in rapidly increasing numbers. More and more of the major air lines are demanding B. F. Goodrich E. T. Brakes on their transport planes . . . they are a favorite of light plane owners everywhere.

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER  
AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

Airplane landings inside a building make  
**SAFER LANDINGS OUT-OF-DOORS!**



**OPERATION** of the Expander Tube principle. A rubber tube fills with fluid and expands. This forces the several brake blocks apart into contact with the brake lining. Control is effected smoothly and evenly all around the brake drum.



**SAFER FLYING AGAINST** developed by B. F. Goodrich engineers has not only been responsible for many improvements in E. T. Brakes . . . but was actually responsible for the development of the first steel-wire wheel and tire. Wheel and tire is now considered to be the standard of safety. Both wheel cameras as adjustable speeds and loads. Material are so treated against running road wear, thus reducing impact of a plane's landing. Brakes are applied and overcome critical pressure on brakes and landing gear . . . The much lighter landing gear allows for the development of a new landing gear efficiency E. T. Brakes. A new landing gear unit, the main nodules and bush, is now under construction at the Goodrich Laboratories.



**SAFER FLYING AGAINST** With warships sailing extended over areas ranging from green fields to calm ocean waters, a question of vital importance is "How does temperature affect the E. T. Brakes?" To supply the answer to this, B. F. Goodrich engineers performed with strict methods. An electrically heated bath was used with temperatures controlled between 75° F. and 100° F. To test the new temperature, an ice bath was developed which had temperatures ranging from 75° F. to 50° F. below zero. Pressure on the Expander Tube can be raised from 6 to 500 lb. per sq. inch. The resulting tests are the most accurate confirmation such as this is what makes B. F. Goodrich truly "First in Rubber."

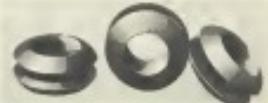
*In war or peace*  
**By Goodrich**  
**FIRST IN RUBBER**



**FABRICK B. F. GOODRICH ST-HORSE**—One of the greatest contributions to flying safety is the B. F. Goodrich De-Lite. A short of specially compounded rubber containing tubes is clamped to the leading edge of the propeller blade at the hub. These tubes are inflated to a pressure by an engine-driven air pump. Thus, to set forces on a plane's wings, the pulsating rubber tubes cause a reaction and the aircraft swings in the direction. B. F. Goodrich De-Lites are now used by the country's leading airlines and are standard equipment on many types of military aircraft.



**B. F. GOODRICH AIRLINE TIRE** is built throughout with Duonite, the B. F. Goodrich "Tire Virtue" that greatly increases the tensile strength of rubber. Today thousands of planes are riding their power on Schenck tireless tires of all types... from light two-place aircraft and private planes to huge commercial and military transport aircraft.



**B. F. GOODRICH AIRLINE TIRES** are built throughout with Duonite, the B. F. Goodrich "Tire Virtue" that greatly increases the tensile strength of rubber. Today thousands of planes are riding their power on Schenck tireless tires of all types... from light two-place aircraft and private planes to huge commercial and military transport aircraft.

**B. F. GOODRICH-AERONAUTICAL DIVISION - AKRON, OHIO**



## FULL SPEED on the road to VICTORY!

The greatly increased floor space and equipment announced a year ago are being used at full capacity for Marcell propeller production. Expanded production, but set the digitized lat-down in the ideal which have made the Marcell trademark "a mark of experienced design and honest craftsmanship."

**KARTZELL  
PROPELLER COMPANY  
PIQUE, OHIO U.S.A.**

### KEEP FLOODLIGHTS TURNING!



### Roto-sho ELECTRIC TURNTABLES

14 inch TABLE  
Circular 300 lbs.

48 inch TABLE  
Circular 100 lbs.

100 inch TABLE  
Circular 40 lbs.

All steel 16 gauge

Operator surfaces

Guaranteed 1 year

Self starting

110 V.C. at 60 cycles

### Special Setups to Order

**GENERAL  
BIEAN STAMPING CORP.**  
265 CANAL STREET  
NEW YORK CITY, N.Y.

axis driven by a single radial bearing which gives twice the stability of a conventional bearing and eliminates wear between the bearing and the housing. The elimination of the bearing and eliminating danger of tube damage used to have been caused to 30,000,000 aircraft worldwide. The new bearing is available for aircraft or auto, and is rated at 20,000 rpm, 110 v., max hp.—American, April, 1942

### Pipes Tube Cut-Off Machine

For high production cutting of quantities of tube or rod to the same length, The Penn Engineering Co., 122 Main St., Estes, IL, have a new automatic model model. The one consists of a simple power source, a motor, a flywheel, a belt, a driven friction saw or abrasive disk on a carriage carriage, driven by a small V-belt drive, and both motor and saw are mounted upon a single carriage, given on each bearing either side of the carriage a wide range of motion resulting in ready adjustable action. An automatic clutch, which holds tube during cutting, causes automatically at handle or pedestal over carriage a

**CLEVELAND  
AIRCRAFT  
LEATHERS**  
*All grades... All types*

... hold the  
**SPOT-LIGHT**

with

**AEROKROME**

In low-light combat demands, Cleveland Tanning Company has resulted in the development of a real leader... a chemically stabilized and ultrafine leather covering for your aircraft we...  
AEROKROME. The specified leather product is a light weight, wear-resistant, tough covering for aircraft interiors which is available in a full line of basic or regulation colored leather for upholstering and general covering requirements. And, AEROKROME may be hot dipped or folded to meet required colors.

Knowledge and experience stand behind Cleveland Tanning Aircraft Leather... Cleveland Tanning Company is one of the few remaining companies to manufacture and supply all types of commercial leather. This knowledge is available to the engineering and production staffs of important defense units. Inquiries are invited! Cleveland goods are your leather requirements.

50 Years in Leather  
**CLEVELAND TANNING  
Company**  
SOLE SELLING AGENT FOR  
PLUMER LEATHER COMPANY INC.  
FRANCIS AVE. & KENWOOD RD.  
CLEVELAND, OHIO



**FLEETWINGS**  
helps U.S. Eaglets  
to Soar!



**STURDY** and maneuverable, this sleek new Fleetwings biplane has proven to be a ship that U. S. Army flyers are proud to pilot.

She's got 100 "horses" under her unshielded engine cowling, she's all welded . . . the world's first seaplane built principally of stainless steel!

Fleetwings engineers . . . who have

pledged to designing and building both airframe and seaplane parts . . . who have developed new techniques for fabricating stainless steel, aluminum alloys and other materials . . . are pleased but not surprised by the heavy 60-second the RTT/Gary Uncle Sam's bladders.

Fleetwings, while concentrating on

immediate production jobs, is also active in today's developments that assure bigger, faster, tougher seaplanes for tomorrow.

**FLEETWINGS**  
Incorporated  
BRISTOL - PENNSYLVANIA

AVIATION, April 1941



Stainless steel ribs for fast seaplanes are now speedily formed at Fleetwings . . . more than 15 ribs in one operation . . . due to the unique press with four forming stations. Electroless production engineers have found that new processes can easily attain greater tolerances than the other standard methods. Fleetwings' strength lies in its ability to produce . . . incorporating new mobile jigs and fixtures, multiple-staged welding units, and other techniques that make their job and quality increased output.



To speed spot welding of Alclad, Fleetwings has developed a new chemical cleaning process. For mass-production cleaning of Alclad aircraft skin panels, this Fleetwings method permits spotwashing at any time within three days after cleaning, and also helps produce consistently good welds. Wait desired?



"Doffs make perfection, and perfection is no trifle." Making hydraulic equipment . . . fabricating carbonite heat exchangers . . . reducing . . . lowering fuel consumption . . . better, taller wings and other aircraft parts . . . these jobs call for continuous welding. Fleetwings engineers found that by using the latest welding methods and other equipment with high amperage and highest voltage outputs, the production of quality aircraft precision parts became a reality. This is the secret of the "Fleetwings touch" that helps Fleetwings get planes in the air faster!

"KEEP 'EM FLYING!"

**FLEETWINGS**  
Incorporated  
BRISTOL - PENNSYLVANIA

efficiency resulting, water-cooled coils are largely non-existent. Steel is an ideal conductor and is used to reduce overheating on a physical rather than on a chemical basis. There like processes eliminate the need for cooling jackets, from which the heat is removed. The jacket should be covered at sufficient coil strength, the personnel concerned responsible for carrying aluminum parts in 100°-145° deg. F. The tubes taking the heat from the free air are made of copper and are used for vacuum pump cases or various low temperature applications in a tube by filling a basket with the substance from the left tank and applying the tube to a work section with oven.

Arlington, April 1941

inches of 200 mph range recently delivered for the Army by Kalmus Instrument Div. of D. C. Co., 48-68 6th Ave., Elizabeth, N. J. In this case the instrument is calibrated in per hour, as indicated by the reading scale dial. The pointer makes seven complete revolutions at the dial face the full range, or one revolution for every hundred mph. An input dial is used to set up any speed. A Kalmus Service Speed Indicator is also available in 800 and 600 mph ranges.—Arlington, April 1941

#### Truck Blackout Ventilators

For service blackout claim, The Trux Co., Inc., Coeur, Wash., offers positive ventilation with their Blackout Ventilators. These are available in three basic models: Standard and Economy. Both have bright light and weather seal. The Economy Supply Unit is designed to provide large volumes of cool air. Use of a unit of this type is generally found necessary to force air-currents away or where ventilation is

desire of the new Speed Wind Set made by Aero Tool Co., Burbank, Calif. Positive Readjustment, even when operating at high speeds, is possible by the full control action. An extra large 12-in. fan on the right set combines with the control to smooth and even out rather than mix or dead shake when moving from one extreme to another. Magnetic Polishing is claimed to produce a mirror-like finish with a uniformly accurate measured bore. Construction is from best treated alloy steels. Return action is achieved by a tapered ball and socket joint with a single center collar.—Arlington, April 1941

#### Speed Indicator

Increasing speed of military aircraft is reflected in the new sensitive air speed



indicator. Industrial pressure is another. Commercial types of aircraft indicators are being used by the Federal Government, but are not exact for aircraft, whereby air is occupied areas is exhausted from the building and the air is taken from the outside instead of air being introduced. It is necessary to provide a mechanical means of removing the air current says the Weather Supply Unit. The instrument is connected to an intake duct for intake air. It contains heating coils, face and figure dials, and pressure gages. Said to be easy to install, unit includes glass-enclosed motor and can be repaired without removing the cover or cover plate.

All instruments can be manufactured as required.—Arlington, April 1941

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# No Other Metal Has *all* the Good



ORIGINAL PHOTOGRAPH BY E. T. COPE

## REPUBLIC *Enduro*

Other Republic products include Alloy Steels—Electroline® Aircraft Tubing—Upright Bolts, Nuts and

## Qualities of Stainless Steel!

Some metals—alloy steels, for instance—possess, among other qualities, high strength and toughness. Some may resist corrosion, oxidation or abrasion. Still others may be readily fabricated and welded. Most metals have one or several outstanding qualities.

But no other metal provides all these qualities in the uniformly high degree found in stainless steel—especially Republic ENDURO® Stainless Steel.

Republic ENDURO provides high strength-to-weight ratio; high resistance to corrosion, elevated temperatures and wear; resistance to stress in sub-zero use. It is easy to weld—may be machined and otherwise worked without difficulty.

For this reason, ENDURO has become one of the essential materials of the Aviation Industry—and more and more of Republic's

Repairs

tremendous capacity as the world's largest producer of alloy, stainless and "aircraft quality" steels is being delivered to plane and engine makers to swell the stream of Production for Victory.

Its qualities are helping produce better wing structures, control surfaces, cowling, fire walls, ammunition boxes and chutes, collector rings, supercharger parts, exhaust stacks, air intake pipes, oil tanks, pontoons, radiators and other important parts of our rapidly growing air armada.

*Specific details and technical data on Republic ENDURO Stainless Steel, together with information on fabrication and welding, are contained in an interesting series of books. Ask us for whatever information you would like to have.*

### REPUBLIC STEEL CORPORATION

Army Steel Division, Massillon, Ohio • Second Offices, Cleveland, Ohio  
Republic Steel Manufacturing Division • Canton Division  
Miller Steel Products Division • Brazil and Toledo Divisions  
Waukegan Steel Division • Tennessee Steel Company



## STAINLESS STEEL

Rivets—Pipe—Sheets—Truscon Hanger Doors and Building Products—Berger Lockers and Shelving.



# SCHATZ

*Precision*

## AIRCRAFT BALL BEARINGS



SCHATZ PIONEERED IN THE BALL BEARING INDUSTRY • INTRODUCED MANY IMPROVEMENTS IN CONSTRUCTION • ESTABLISHED NEW STANDARDS IN BALL BEARING PRACTICE • THIS SKILL, KNOWLEDGE AND EXPERIENCE IS TODAY REFLECTED IN THE SUPERIOR PERFORMANCE OF ALL SCHATZ CONTROL BEARINGS \*



THE SCHATZ MANUFACTURING CO.  
POUGHKESSIE, N.Y.

Bethel Office: 9440 New Haven • Chicago Office: 802 S. Wabash Ave.  
General Office: 401 Madison Building • Los Angeles Office: 2417 Wilshire Blvd.

AVIATION April 1942

## AVIATION'S SUBCONTRACTORS SECTION

IN THIS NEW SUBCONTRACTORS SECTION, Aviation offers a service designed to simplify the search for outside manufacturing facilities and thus speed the process of subcontracting.

The production goal of 60,000 military planes during 1942, and 125,000 in 1943, is one of the greatest industrial projects of all time, involving a vast expansion in subcontracting.

It is the purpose of this section to serve as a meeting place between prime contractor and subcontractor.

Here, manufacturers desiring subcontract work from the aviation industry can make known their facilities, capacity, and ability to serve.

Here, subcontracting facilities may be quickly brought to the attention of firms who urgently need them.

The pages of Aviation have long served as a meeting-place for prime and subcontractor, and we believe this new section will render a greatly-needed service demanded by our war-time aircraft program.





**Sure—Simple—  
Snap-action—Unaffected  
by altitude, shock, or vibration**

One of the principal advantages of Klixon Controls is that they are opened by snap acting thermistor discs. And this means that they are free from snap or cam-locking action—therefore, simpler in construction, lighter in weight, positive in operation, unaffected by vibration, and unaffected by a wide range of temperature conditions. The thermistor discs used in these controls are scientifically calibrated to give the required performance. And the construction of each unit is made to meet maximum space and weight requirements.

All of these controls have been tested in conditioned and unconditioned environments. "Reliability" and their proven performance make them ready and able for application in the plane you are building for war.

Write for complete information on any of these controls.



#### KLIXON AIRCRAFT CIRCUIT BREAKERS

These breakers—push button and toggle types—are available in ratings up to 100 amperes. They break high voltage capacitors—can light incandescent lamps—and give complete loadproof protection to aircraft circuits. Ideal for fuselage mounting completely.

# KLIXON

General Thermistor Co., Allston, Massachusetts

MANUFACTURERS OF THERMISTORS AND TEMPERATURE CONTROLS FOR AIRCRAFT CABINS, RADARS, ENGINES AND INSTRUMENTS

#### 10,000 Contractors

Subcontractors to aircraft industry are approaching a total of 10,000 units. National Chamber of Commerce.

In addition, the work is spread among nearly 20,000 precision subcontractors. Subcontracting is foremost work to be done in specification, while reading is employed standard parts and materials they hold were and parts.

Process parts subcontracted are: central surfaces, engine mounts, landing gear, wing tips, body seats, various mechanisms, etc.

Subcontractors now supplying aircraft equipment formerly produced such things as aircraft instruments, reading and sketch, private planes, lighter than air craft, camera, station models, etc.

In 1942, 268 plants in 80 cities supplied parts for the B-17s. This year more than 1000 are involved. Form for another place comes from 250 cities in 26 states; vehicles in all 31 states supply the same project.

An aircraft instrument company estimates that as 180 subcontractors alone do 200 man-hours of work a month do aircraft contractors even more work. Most of these contractors are engaged in maintenance engineering, static test work with the subcontractor. This includes a large percentage of machine tool firms, electrical producers, the five instrument and precision of aircraft construction.

#### NEW SUBCONTRACTING PLAN

The WPA and National Association of Manufacturers are about to conduct a series of experiments to test the "renting office" plan for distributing war production work in the Chicago and ten or three other areas.

The plan's principal feature is a directory of subcontracting opportunities compiled by a central Bureau and made available to government subcontractors each week. All details of contracts, weights, numbers and deadlines are taken from the prime contractor's master operating sheet on an as-needed basis and sent to Washington for filing in the directory.

The prime contractor specifies in his sheets the type of machinery required to produce the job and describes the essential phases of the operation. The general subcontractor has to submit a corresponding model to his manufacturer, receives the necessary cash while loaned through it for the sole description of his own machinery and determines whether or not there is a job available for him.

The NAM is understood to be preparing a wide distribution of the details of this plan to all potential subcontractors. Arrangements are also being made for meetings with prime manufacturers in the areas to be tested.

## Veterans of the Airlines...



Top: The Douglas DC-3 in flight. Bottom: An DC-3 cockpit window. Right: The logo of the Douglas Aircraft Company.

## DOUGLAS DC TRANSPORTS and ELASTIC STOP NUTS

Since 1938, more than 800 Douglas DC Series Transport Airplanes . . . in the air 300,400,000 hours . . . have flown over 380,000,000 miles. The meaning of this remarkable record, in terms of safe and rapid transportation, is well known.

One important reason for this performance, and for the fact that these ships are still in top flying condition, is that they are fastened throughout with vibration-proof Elastic Stop Nuts . . . more than 30,000 on each ship.

These self-locking self-gripping nuts are used today, at vital structural and secondary connections, on every military and transport airplane built on the Western Hemisphere . . . and on innumerable other classes of mechanical and electrical equipment . . . including many of America's tools of war.

**Key Elastic Stop nuts**  
are your products and equipment. Simple sets will be furnished without cost or obligation.

CATALOGUE  
ON REQUEST

ELASTIC STOP NUT CORPORATION  
2100 NATIONAL ROAD • UNION, NEW JERSEY

# Elastic Stop NUTS

SELF-LOCKING  
AND AIRCRAFT FITTINGS



# How to pull extra Man Hours out of a Glass Tube...



**THE REFRIGERATOR** is just one of thousands of products needed in the war effort. And many of these products must be made at very particular times if their places are going to continue to produce. If they can't keep a constant lighting system, choose from these new possibilities of their present lighting by reading and choosing lamps and fixtures, or putting walls and ceilings in light colors and by adding more light, and by adding more lamps. General Electric has already invented 400 different lamps.



**TODAY IN 7 MODERN PLANTS** men and women work night and day to make the thin glass tubes that are helping war workers produce more tanks and bombers and antiaircraft guns. Back of these G-E Research Lamp Factories is G-E's Lamp Development Laboratory, where there is a row of many workers constantly checking to see that G-E MAZDA lamps are brighter longer.



**10 MILLS OF G-E MAZDA Lamps** are manufactured in this typical new warplane plant. Officials are impressed by the speed with which each plant is built. And the speed with which each plant is built is a sure sign of how much faster and more efficient lighting can be.

Read how G-E Fluorescent lighting — America's new 24-hour daylight — is adding millions of productive man-hours to wartime industry by speeding production... reducing spoilage... preventing accidents... making seeing easier.



**IN AMERICAN PLANE PRODUCTION** planes we build, more planes will be built on a fixed or tight budget. Improved methods like this flying factory are being used today due to the cost savings brought by G-E MAZDA F lamps. By the numbers speak the truth. By increasing an average plane, says a wartime study, 10% more hours are saved. This means the war is being won faster, planes are being turned out earlier, and aircraft are more effective. American troops like this are pleased without adding extra floor space, electricity, or fuel bills!



**THE BATTLE OF 1943** — America's biggest and most important warplane plant is now producing more aircraft than ever before. And the secret of its success is G-E MAZDA F lamps. In this plant, workers are approaching their jobs with a new sense of enthusiasm. They are working harder, faster, and more efficiently. And they are doing it with ordinary lamps.



**NO TIME OUT** when work goes on a warplane in the 34th "factory daylight"! In this G-E plant, G-E MAZDA F lamps were installed in this size plant, now producing a real war weapon. Production is speeded up. Workers are happier, less tired, because they maintain energy through better seeing. Demand? 100,000 G-E lamp supplies to war! General Electric Co., Nela Park, Cleveland, Ohio.



**FOR TEA BREAKFAST TABLES** are served in big plants now. G-E Fluorescent lighting was installed. By cutting costs lighting is used judiciously; you can add more workers around breakfast, save money, and do other jobs more effectively.



**CONFIDENTIERS MANUFACTURED** under code name 700 Business Machines which are built and tested by Universal Lamp Laboratories to exacting specifications for postal service. To send your business correspondence direct call 2-1444 or KU 2-1010.

**G-E MAZDA LAMPS**  
**GENERAL ELECTRIC**  
Made to stay brighter longer

# RIGID TESTS KEEP QUALITY OF FORMICA CONTROL PULLEYS HIGH!

- 1** Each pulley is tested for weight that might be due to the bearing housing associated with slight magnetism in the pulley.
- 2** The exact amount of force is determined that would be required to pull the bearing assembly off the pulley. This starts second requirement.
- 3** The diameter of the groove in the pulley through which the cable runs is checked along with center of the bear of the groove to be sure the cable will fit.
- 4** A second test is made for load on one or two cable bearings itself, at any eccentricity to the hubcenter of the pulley.
- 5** Precision tools are used to determine the amount of force that would be required to locate the bearing of the pulley.
- 6** A sheet lead test is made—an accurate percentage of pulleys to determine the weight and how the pulley will react without breaking down.
- 7** Pulleys are also tested on a dynamometer to determine the horsepower point under torque caused by frequent reversals in the direction of rotation.

FORMICA control pulleys for airplanes consistently exceed the requirements of Army and Navy specifications by a wide margin of safety. To make sure that they do, tests have been developed for each quality covered by the specifications and these are rigidly applied to be sure that daily shipments—running in thousands of pulleys—meet the requirements.

This exactness in manufacture is added to a material that has important fundamental qualities that adapt it to airplane use. It is lighter than metal (specific gravity 1.3). It resists moisture absorption and the dimensional changes that are caused by it; it has a low coefficient of thermal expansion; it is chemically inert and safe from corrosion under a wide range of conditions.

Hence its widespread and growing use not only for pulleys but for many machined parts on nearly all American Airplanes . . . Send for the Formica catalog of airplane parts.

The Formica Insulation Co., 4638 Spring Grove Ave., Cincinnati, O.

## FORMICA



# NORMA-HOFFMANN

## PRECISION BEARINGS



for

## AIRCRAFT CONTROLS

Identified with the aircraft industry from its earliest days, NORMA-HOFFMANN pioneered many of the important bearing types now accepted as standard in aviation practice. \*\*\*\* Today, almost every responsible builder of aircraft, engines, instruments, and equipment—including the United States Government—employs NORMA-HOFFMANN PRECISION BEARINGS to insure safety and long, uninterrupted service. \*\*\*\* Typical NORMA-HOFFMANN Aircraft Bearings are here illustrated. Write for the general Engineering Catalog which describes 108 distinct series embracing over 3000 sizes—a PRECISION BEARING for every load, speed and duty.

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U.S.A.

PRECISION BALL, ROLLER AND THRUST BEARINGS

# National's PART IN AMERICA'S WAR PROGRAM



In every branch of Uncle Sam's Armed Forces you will find National Quality Sand and Permanent Mold Aluminum Castings. Because of our long experience in making quality products, we were selected to produce castings for every branch of Uncle Sam's Armed Forces...A good thing to remember when normal times arrive.



*Make*

**NATIONAL Your Source of Supply**

FOR SAND AND PERMANENT MOLD  
ALUMINUM CASTINGS

**National**  
CASTINGS  
ARE BEING WIDELY  
USED TO SPEED  
VICTORY

THE NATIONAL BRONZE AND ALUMINUM FOUNDRY CO.

Twin Parks, Cleveland, Ohio

NEW YORK, 33 Broadway  
DETROIT, Stepulverne Rd.

CHICAGO, 186 W Randolph  
LOS ANGELES, 405 S Hill

## SIDE SLIPS



\*WE HAPPIERED to be present on a very hot afternoon recently. Some men were working in the sun, the words in back of me old "Jenny" was suddenly off the ground, went into a flat, one simple roll and crashed. Otherwise it simply got off and stayed there or four or five of the ground and smoky obstacles interrupted the flight.

Owing to a miscalculation, the intruder had been descended only with lines which always caused spectators to what they had been intended for. They saw numerous places for hanging gloves, hooking up the speaking tube for the station, making a radial loop or two, and enabled one to put the chewing gum in the back of the head.

The engine was crated downward

permanently for visibility, however we couldn't help but wonder what the stability characteristics had been before that. The under arms crossed the scapulae with greatest and the craniac of nose out in a hot flood if the top of the crop held the ship inverted for so long. Everything on the signal was exposed to the elements and when a man stood up to the magnets, the pilot obtained the last spot available within two minutes of flying time.

The intruder came in the "golden circle," indicating when he stopped to land when the Jenny spun in, whereina (Turn to page 264)



weather, complete with the 40,000 feet at which today's air battles are being fought.

However, it was a fearful and wretched machine which had been devised by Glenn Curtiss and his crew of geniuses. Many of them genuine came from the firm whose Headquarters, N. Y., and some of them are back on their native farms, happy and content in the knowledge that they have helped in the construction of modern aviation.

Drawings for the Jenny were made on white-washed factory walls, and design was accomplished by shooting off and splicing it the longeron, boom, or stern swivel. It is surprising how close they came to the exact structural and many a modern designer is still unable to do better than is suggested by another engineer of 1914 vintage.

Flying a Jenny was a liberal education in itself. Never a dull moment. After an appropriate period of warming up, one "reved a leg," and if satisfied with the rachetized reading, went away the wheel shears, gave her the gun, and started on adventure.

The experienced pilot would sit at the gas in the lee of trees at the end of the field, for the shooting on a Jenny



"Magpie is trying to fly like a biplane like those new tail-fort jobs, but he can't keep his shirttail down!"





## Security Airster

In three minutes' time, one man can convert the 40 ft. wing span of this plane into a convenient width of 13 ft. 4 in.

**A**N ITCH of an aerial mosquito to operators, who must not store space or build their own hangars, is the folding wing arrangement on the Security Airster, built by the Standard Airplane & Motor Co., Los Angeles, Calif.

Designed by a Security S-3 125 hp engine powered by Mr. R. Rieser, chief engineer of the company, the Airster is a two place, side-by-side low wing model with dual controls. Top speed is 120 mph at 15,000 rpm, and landing speed 45 mph, which would make the ship adaptable to small, rough landing fields. Service ceiling is 18,000 ft. with an absolute ceiling of 20,000 ft. Initial climb rate is 5000 ft. in 3 min.; 10,000 ft. in 12 min.; 15,000 ft. in 18 min.; 18,000 ft. in 30 min.

Fairly conservative in its welded chrome molybdenum steel tubing, as are the wing struts, formed integral with the bridge, and all tail surfaces. A rigid girder effect has been secured in the wings by double bolting all re-

lentil drag members and the positive locking mechanism for the patented folding arrangement is standard equipment. The Airster is also equipped with a swiveling motor mount, permitting easy access to the rear of the engine for routine service operations. Good field performance is the result of the compact, rugged design, the spacious cockpit-shaped enclosure of which sides backwoods for entrance as easily. Landing gear is the hydraulic type with integral expanding brakes.

The Security S-3 engine is a 4-cylinder, 4-blade radial weighing 220 lb. complete. Aluminum alloy cylinder heads are shrouded in the special alloy cylinder and held with a single gasket. Oil filter is a separate unit. Cool air intake radiator and heat exchanger units are all tight, with continuously lubricated cooler arms. To assist in cooling, valves are set at a wide angle and not actuated by a single 3-hole cam-shaft, turning in clockwise rotation and revolving concentric with the shaft. Hinge type con-

## Flying Equipment

followers relieve the support loads of all side thrust, which increases the life of the upper rod bearings. A suitable feature at the master end construction. This is a steel backed, helical gear bearing shell split on the vertical axis of the rod and located with dowels.

The engine is set directly on its aluminum base in the engine room. There are two anti-friction cylindrical bearings and one sleeve type, and a large thrust bearing is externally rotated for better cooling. Dual carburetor operation with full automatic spark advance is provided. Current is supplied to the battery by a Champion generator, of the high output type, the charging rate being automatically regulated. Any electrical power may be required.

Both the Security Airster and engine were manufactured by the American Aircraft Corp., Long Beach, Calif., but all motors and manufacture rights have been taken over by the National Aircraft & Motor Co., present producers. Specifications and performance data on the Airster see:

	Specs. with Wings folded	Specs. with Wings extended
Length	21 ft. 10 in.	31 ft. 6 in.
Width	13 ft. 4 in.	40 ft.
Height	6 ft. 10 in.	6 ft. 10 in.
Wing area	200 sq. ft.	200 sq. ft.
Empty weight	1000 lb.	1000 lb.
Gross weight	1600 lb.	1600 lb.
Take-off weight	1600 lb.	1600 lb.
Max. speed	120 mph	120 mph
Cruise speed	100 mph	100 mph
Landing speed	45 mph	45 mph
Initial climb	5000 ft. in 3 min.	5000 ft. in 3 min.
Service ceiling	18,000 ft.	18,000 ft.
Altitude climb	10,000 ft. in 12 min.	10,000 ft. in 12 min.
Absolute ceiling	20,000 ft.	20,000 ft.

Designed by W. E. Gleason, the Security S-3 engine features responsive and strong R.R.



The Airster landing gear consists of a welded chrome molybdenum steel landing gear.

AVIATION, April, 1942

# If you MUST have Stainless!

*We have the capacity to fill  
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If you are building aircraft or aviation equipment vital to the war effort of the United Nations, we can give you prompt shipment of U.S.S. Stainless Steel for applications where its properties make it the best material.

Long before Pearl Harbor we were acutely conscious of the growing importance of Stainless Steel as a vital necessity in the production of aircraft for war. So our production engineers

wanted no time in preparing to meet the mounting demand. Not only have we increased our capacity, but we have ready available the industry's widest range of sizes and shapes in U.S.S. Stainless Steel.

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UNITED STATES STEEL

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BORING IN ENGINE ALUMINUM. In a similar aviation manufacturing operation at Boeing, Texas Production During the last year or two, increased the life of the boring tool... the operators liked the rate and the tool's performance.

AVIATION manufacturers are "keeping 'em rolling" so that the tops can "keep 'em flying." Gigantic plants, machine shops, assembly lines . . . specialised machine-tools, high-speed, streamlined methods are in general use.

The demand is for men, machine, methods, that go inside Precision aircraft; these are our staff of Texaco Engineers specializing in cutting conditions who are at your service with help that will increase output, improve quality of work and prolong engine life.

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FOR THE AVIATION INDUSTRY**

REBURN METAL DRUMS PRIORITY

FRED ALLEN, every Sunday in 1941. See your local newspaper for time and date.

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AVIATION, April 1942

## Producing Maintenance Men

An aviation school trains maintenance and service men for the Air Forces and commercial services

By W. C. ERS  
Author, Research Aviation School

FOR MANY YEARS, Research Aviation School has been one of the country's outstanding aviation pilot and mechanic schools. Taking stock of its facilities and capabilities for contributing to the nation's war effort, the directors of the school promptly served an order to expand facilities as to the utilization of family and plant during the war period.

Recognizing the critical need for well-trained maintenance and service men for the Army, the privately operated military flying training schools, and for the commercial air-mail operation centers, the school determined to make an all-out effort to supply these needs efficiently and promptly.

Today, the entire facilities of the school are devoted to the training out of maintenance and service men. The Army school is completely out of the picture.

Nearly one-half of the school's facilities have been turned over to the exclusive job of training enlisted Army men for maintenance and service duties in the military operational bases. The course is conducted by the regular

This is the enormous wing repair department. A damaged wing from a Stinson MS-4 is being dismantled preparatory to rebuilding. All work is done under the eye of qualified inspection and quality control inspectors. There is no time lost for the completion of this work, the only objective being quality of work and thoroughness of inspections.

Maintenance and service men may be called upon to do anything from cleaning a spark plug to rebuilding an airplane. The student is given thorough training in the use and working of tools in a completely equipped metal working shop. Here is a student operating a heavy duty welding machine. This is more than just an exercise, for the part he is working on will go into actual service.



A section of the assembly engine department while students receive instruction and practice to prepare them for the advanced and difficult duties in the aircraft division. These men work on engines of all types in actual service. In the Army schools of the school, the different types of military power plants are worked on by the students.



You actually get the performance of  
**2 EXTRA Presses** with the versatile

**HPM**

## FASTRaverse TRIPLE-ACTION DEEP METAL DRAWING PRESS



Use it as a single-action, double-action or triple-action press... the job will be done with minimum change-over, stoppage and production costs. This versatility has won the HPM Fastraverse Triple-Action Deep Metal Drawing Press an important place in today's all-out production of the Nation's aircraft and armament plants.

The Hydraulic Press Mfg. Company  
Mount Pleasant, Ohio, U.S.A.

Representatives: New York, Atlanta, Boston,  
Chicago, Minneapolis, Philadelphia, St. Louis

— ONLY  
ADJUST ONE  
DIAL, OPERATE  
THIS MACHINE

The 300-ton HPM Fastraverse triple-action press shown is drawing all kinds of deep parts from 1/8" to 1" thick at a rate of 150 parts per hour. Other parts are typical of the variety of work made on this press to meet the needs of aircraft and armament plants. Shown here are: 22x10" deep 1/8" wall, drawn 20x8" deep

A group of Army students in the lip-draws laboratory. The apparatus shown in the picture is a hydraulic "tear-off" device used by the school to demonstrate the operation of an airplane's hydraulically operated landing gear, brakes, and flaps.



An Army trainee is learning how to test generators on an Allis Chalmers machine. The generator was supplied and rebuilt by the students.

This is a test unit in the advanced engine department for the testing of overhauled and rebuilt magneto. Performance at various speeds is observed with the aid of the tachometer mounted on the panel.

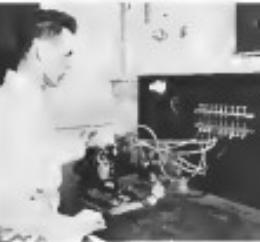
the press of wartime conditions

Prior to the outbreak of war, the principal "battle experience" provided Army students by their universities was the flying of small numbers of aircraft aircraft on a regular commercial basis.

This situation has not been made to the detriment of thorough and complete training of maintenance men to meet the exacting requirements of the over-all aircraft and flying schools. A more efficient utilization of facilities and the addition of more equipment, where necessary, has increased the capacity of the courses in the maintenance of aircraft engines. In fact, the course has been expanded in scope to more adequately meet the student to meet the increasingly difficult task of maintaining military drawing and commercial aircraft under

an instructor is explaining the construction and operation of a hydraulic propeller in future Army maintenance and service men.

Twelve Army students are receiving instruction in the construction, repair and operation of instruments in the instrument laboratory of the Army maintenance and service school.





"ATTACK DIVING" by John Shuster

**A SAFE 680 M.P.H.**—It takes exceptional engineering to build an airplane that is safe in a 680 m.p.h. dive. Thrusting downward at this prodigious speed—or overshooting, catalyzing, outgunning all contemporaries—the sensational Republic P-47 THUNDERBOLT is the tangible expression of the high engineering skill which planned it to the last detail. Republic Aviation Corporation, Farmingdale, Long Island, N. Y.



**REPUBLIC AVIATION**



One of a considerable number of American barrage balloons guarding military objectives in the Pacific Northwest. These balloons are under Coast Artillery Command.

In THEORY and in general practice, aerial defense in Britain is divided into layers or zones of defense altitudes. The highest altitude defense zone above effective anti-aircraft仰射, the next lower is controlled by the range of the aircraft, but this zone has a lower limit beneath which it is difficult or impossible for man to operate, either because of danger or damage to fixed property, or because of necessity of fire against aircraft moving rapidly at low altitude. This lower limit is established at around 3,500 feet. It is the function of the balloon barrage to cover the area of the defended position up to that limit.

#### AIRPORT WINCHES USED

The gas bags themselves are drawn to carry a cable sufficiently strong, and therefore heavy, to be destructive to the enemy aircraft as required. The present British standard type of balloon has a capacity of 20,000 cu. ft. and is inflated with hydrogen. High altitude types of much larger capacities have been used—the French five balloons up to 20,000 ft.—but the weight and strength of the cable had to be reduced until it did not possess the necessary destruction power.

The ground equipment for the balloon is carefully designed to provide

standardization, using components easily obtained, reliability and ease of operation by unskilled crews. The track which carries the weight is a standard heavy steel chain with a Fairbairn winch mounted on it to operate the wheel, and which is controlled exactly the same way as a car—foot clutch, brake, etc.

#### BALLOON SPACING

The gas bags themselves are drawn to carry a cable sufficiently strong, and therefore heavy, to be destructive to the enemy aircraft as required. The present British standard type of balloon has a capacity of 20,000 cu. ft. and is inflated with hydrogen. High altitude types of much larger capacities have been used—the French five balloons up to 20,000 ft.—but the weight and strength of the cable had to be reduced until it did not possess the necessary destruction power.

(Turn to page 214)

# Barrage Balloons Over Land And Sea

By J. I. WADDINGTON  
M.A., A.F.C., A.R.

As Americans now look seriously to defense against air attack, British experience becomes of more than economic interest. This article outlines the function and success of the barrage balloon as an integral part of the aerial defense system.

British Combines

At right: A unit of London's aerial balloon barrage system. These units are now issued properly meeting barrage standards. (Inset picture for the view... Below: The "bomber" built on the wings of this modified Gloster Gladiator is designed to carry the aerial barrage balloons defending British cities. There has been no report as to success of these devices, but the added weight reduces the plane's speed and bomb load capacity.





# Announces

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and unloading of parts and sub-assembly shipments. It minimizes, and practically eliminates any possibility of damage during shipment—and permits a maximum load to be handled in minimum space, with much reduced dunnage.

We cannot publish photographs or details of the savings that are being made with this new development, due to the censorship restrictions prevailing during the war emergency.

The next step, therefore, is up to you— — — We solicit your prompt and thorough investigation of this new development as aiding our mutual desire to make America stronger—faster.

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# Airliner Air Conditioning

**A solution to the problem of maintaining constant temperatures in transport planes during lay-over periods.**

By J. A. FERRIS, Facility Director, Northwest Airlines Inc.

Maintaining constant temperatures within the plane while on the ground between arrival and departure times is a problem that has been successfully tackled by Vernon Lundquist of Northwest Airlines.

Because of original limitations, it was impossible to have space available to conduct the process of refrigeration in transport planes. Consequently they sit about a lot of time in the summer and cool quickly in the winter while on the holding ramp. For passenger comfort, it became necessary to have some sort of arrangement to provide conditioned air within the plane to keep the temperature constant.

To meet this problem, the first of a new type of air conditioning installation was made at the Minneapolis terminal of Northwest Airlines. In the basement of the Administrative Building is a central air conditioning unit which supplies heat, water or cold air to the planes via the ramp through an underground duct system terminating at nozzles at the assigned position of incoming planes. The conditioned air is conducted to the plane interior through flexible air hoses drawn from the main duct. Control valves and utility electrical outlets are located conveniently at the nozzle.

In operation, fresh air is drawn

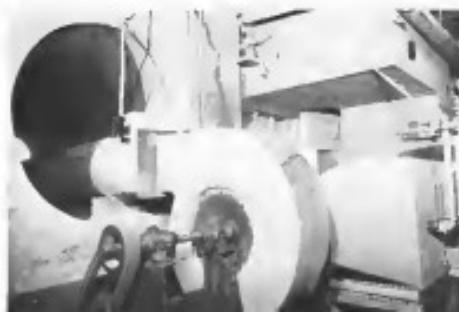
through an automatically opening intake duct and passed through a set of spun glass filters to remove dust and impurities. The air is then passed over heating or cooling coils after which it is forced by a centrifugal fan into duct leading to the distribution system.

During the summer, the cooling coil is supplied with a refrigerant (Freon) which lowers the air temperature to 55 deg. F. In the winter, two return coils are used to heat the air to approximately 140 deg. Steam is supplied through electrically controlled automatic steam valves which open and close as the fan starts and stops.

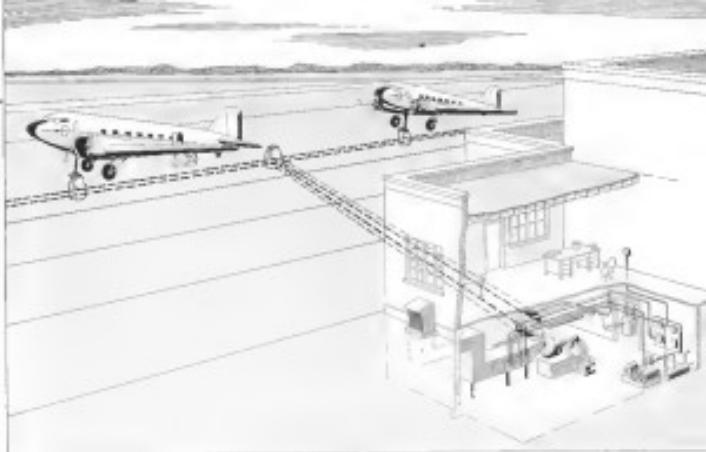
The 18-in. transmission duct extends



When not in use, the air hose is retracted into the nozzle which is connected back with the spray nozzles. Note the location of the central vehicle and utility electric outlets.



The air conditioning unit is the basement of the Administrative Building after being cleaned and heated or cooled. The air is then through the main duct leading to the distribution ducts under the holding ramp.



Schematic diagram of the Northwest Airlines air conditioning system designed to maintain constant temperatures in the planes during lay over periods.

underground from the air conditioning unit to the 12-in. distribution ducts which branch off at approximately right angles under the holding ramp for a distance of 225 ft. In either direction 14 in. diameter flexible air hoses will carry the air to the nozzle outlet at the spray nozzle.

This installation is an important contribution to the comfort of NWA passengers particularly in the summertime of 11 m.s. improves when the passengers prefer to remain in their seats.

Military authorities, too, have shown considerable interest in the installation. The maintaining of uniform temperatures in ground vehicles is necessary when protecting or exposing vital metal parts may seriously damage or impair the efficiency of precision armament fixtures.

For those who have a more detailed interest in the installation, there follows a list of the equipment included in the air conditioning unit.

## AIR CONDITIONING UNIT EQUIPMENT

Filter fan capacity 17 cu. ft./min. consisting of a four cylinder compressor and a 15 hp., 225 volt, 60 cycle 2 phase motor.

Fifteen fan capacity 17 cu. ft./min.

Air conditioning cabinet in which are contained the following:

Motor operated inlet air damper



Set of six three-way type duct valves.

Refrigerant direct expansion coil with a face area of 32x11 in. having a thermal expansion valve and heat exchanger.

Single row tempering nozzle and having a face area of 62 sq. in.

Double row stainless heating coil having a face area of 62 sq. in.

High efficiency type fan delivering approximately 5,800 to 6,000 cfm of air at from 6 to 8 in. H2O static pressure.

Fan motor—2½ hp., 225 volt, 60 cycle, 3 phase, drawing fan at "V" belt drive.

Set of controls consisting of the following:

## Performance Specifications

### Operating Cycle

Desired temperature to maintain	70 deg. F.
Temperature of air entering	70 deg. F.
Temperature of air leaving	125 deg. F.
Flow rate	100,000 cfm
Cooling coil outside	6 in. x 100 ft. H2O
Flow rate	6 in. x 100 ft. H2O

### Design Code

Desired temperature to maintain	70 deg. F.
Temperature of air entering	70 deg. F.
Temperature of air leaving	125 deg. F.
Flow rate	100,000 cfm
Cooling coil outside	6 in. x 100 ft. H2O
Flow rate	6 in. x 100 ft. H2O

(Turn to page 219)

# Greater PRODUCTION MEETS GREATER DEMAND

"With 'all-out' for victory, Weatherhead is answering the need of the hour with dependable aircraft accessory equipment. Each airplane part that Weatherhead produces has been engineered not only for performance but also for speed in production to meet the need so essential today. These parts include Dual Tube and Pipe Fittings, and High, Medium and Low Pressure Flexible Hydraulic Hose Assemblies; also Various Selector and Check Valves, Hydraulic Check Valves, and Hydrostatic Actuating Cylinders.

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# WEATHERHEAD



Laminated wood trusses of the Northwest Airlines hangar at Pergo, N. D.

## Wood Frame Hangar For Northwest Airlines

Thirty wood arches, each 187 ft long, form the frame of the new Northwest Airlines hangar at Pergo, N. D. Constructed to accommodate the giant Douglas DC-3, the hangar will have a maximum height of 35 ft in the center. Ten-foot spacing between the arches gives the hangar a depth of 120 ft, which may be easily exceeded whenever required.

The arches were designed and fabricated by U.S. Structures, Inc., in Wisconsin. They are three-hinged arches, placed up a hill side in a slope. Twelfths of the 12 inches have a cross section of 2½ in wide by 2½ in deep. Built up of 16 beams, each 16x72 in. The trusses are made in 7½x7½-in cross-section to serve as a combination of form and plate for the end wall spandrel frame.

The auxiliary buildings were designed two feet tall over a 40-ft pillar base to permit a clear overhang. Although unenclosed, these units are built to direct fire to the higher structure while enemy planes are forced to fly over them. Thus included full-height shanties at the rear so that if a P-51B fighter can be shot down readily for the 7½x7½-in. truss of the hangar is overhung.

The base of the arch is fitted with a metal shoe bolted on top of each shank, and held in place by a long bolt. Let into the base are two metal plates. These plates, 4 in. in diameter, spread the load from the relatively small bearing area of the heel itself over nearly the entire cross-section of the arch. At the center, where the arch is about 10 in. in diameter, there is a single bolt.

Bent and twisted, broken, and cut was said daily in the arches, which took the valves and the road. No joint was sound for the end

crisis, depending upon the judgment and equipment of the local contractor. The surface of the pavement is raised to make it easier to traverse the immediately adjacent land which may vary a number of times the length of the runway. Planted in deep grass, bushes and trees to blend with the surrounding scenery, it is almost impossible to identify them.

## Air Transport

### Britain's Auxiliary Air Bases

By ERIC E. MARSH

The windows of the old edge of not

putting all your eggs in one basket is being practiced in great style by the British. Two and a half years have taught the Britons of diversified operations which has resulted in airports scattered all over the landscape of the British Isles.

Carefully camouflaged, these bases are hard to detect from the higher altitude at which many planes are forced to fly. In the early days of the war, Britain had no auxiliary air stations, but the modern art of protective observation looks like the observer who sits below believing that he is secure in his station. The proximity of fields is dictated primarily by the safety considerations, since the value of the land for farming purposes has been weighed.

Contrary to the thought of military men, with definite administrative headquarters, large hospitals, flight schools, airports, etc., in complete and orderly. Long paved runways now replace the dirt paths always chosen for their speed and plain looks were used.

Bent and twisted, broken,

and cut was daily in the arches, which took the valves and the road. No joint was sound for the end

crisis, depending upon the judgment and equipment of the local contractor. The surface of the pavement is raised to make it easier to traverse the immediately adjacent land which may vary a number of times the length of the runway. Planted in deep grass, bushes and trees to blend with the surrounding scenery, it is almost impossible to identify them.

Skirting the edge of the field walls hidden among trees and bushes, are what might be called hangars. These consist only of sand bags piled up on three sides the height of the plane and large enough to shield two wings. Free in air space, they are distributed well around the field which keeps the number of aircraft at one location.

The airfield design is truly complete

by connecting roads of the numerous air bases previously created by the army which virtually encircles the landing area with a road. This design assures quick subsequent movement of aircraft between the landing area and storage units. The sand bag hangars provide sufficient space and equipment to check planes and make minor repairs.

Ground traffic regulations are simple, but common. Generally, the planes are parked at the end of the runway, with all engines running, in the direction the aircraft is facing. After the plane lands it moves along the runway to the spot where it cuts off on the turn-around and heads for its designated hangar and then disappears. Simplified ground movements together with hidden approach hangars assist in the possibility of passing out from sight of the base. In the event of an attack damage, it can be repaired quickly in the nature of the permanent tanks and type construction. Ordinarily these auxiliary fields are located in wonder both by the efficiency of their proximity and land availability. They are however, as known as just as military flying and protective consciousness under war conditions.



## Control Tower Operations Recorded On 24-Hour Basis

Important installed in the control tower at San Francisco airport is a dual, push-and-pull, recording and replaying radio recorder which is a means of retaining on the part of the operator, constituting a permanent paper log. This in practice involves loading a microphone, or microphones at a time, into the recorder and then pressing the record and "click" transmitter. Provision has been made for recording seven different channels, should this ever prove necessary.

The installation consists of two small, rectangular units, functioning independently, each containing a microphone plus a built-in electronic-based processor to record messages only. A perfectly normal feature is provision to record outgoing messages only. A perfectly normal feature is provision to record outgoing messages only. The recorder contains three static materials still, an eraser when necessary, or several signals which indicate a clear

transmission and automatically turn power on and off, connect, record and off, with the relay coil disconnected when there is no connection or discharge, prevents overuse of the equipment by static loads.

Where continuous automatic recording is not required a time-clock mechanism may be attached to turn the microphone on and off at pre-determined times, so which case there is a two-second interval for duplication of the time from the disappearance of one signal to the appearance of the next. Use of a recorder.

The machine may be operated manually, or connected to record outgoing messages only. A perfectly normal feature is provision plus a built-in electronic-based processor to record outgoing messages only. The recorder contains three static materials still, an eraser when necessary, or several signals which indicate a clear

channel which must be handled in a day in a sequence. Each disk is equipped with a label upon which the operator may record the date, time and other pertinent data required by the FCC. Dials are stored 40 to the inch in an ordinary filing cabinet.

## Light Weight Transmitter-Receiver

Following extensive tests in military actions, Beech Aircraft, Ltd., of North Hollywood, California, has announced a 45 pound radio system, claiming performance comparable with some heavier sets.

Known as Model 3801, the system comprises two separate units connected together by means of a cable. One unit contains the transmitter and the receiver and can be mounted in any readily accessible location. The other contains the power supply and can be located anywhere in the aircraft.

The transmitter is a six tube superhet with a means of tuned radio frequency amplification. Two frequency bands are provided, one for the beacon channel and the other for communication with the ground and other aircraft. One radio is mounted and a volume control set on its panel.

Jack knobs located at both main panel boards control for microphone, headphones and telephone keys. A built-in antenna relay provides the use of a single antenna for both reception and transmission.

## Battle-Proof Parts

Manufacturers of sensitive radio parts, once fully aware of the fact that components going into ships intended for military use must withstand the shock of gunfire, are redesigning in every design and severe requirement. One good example is the current trend to fused glass windows used in the International Beech Corporation's "Pendleton" Radar-Relay system of aircraft navigation. Another example is seen in the design of CS series sensitive d.c. relays made by the General Controls Company of Glendale, California. These relays are mounted within sealed plastic enclosures with removable insulation roadway, are adjusted to keep their insulating gaps rather than contact spacing.



R. H. Steele, manager of San Francisco's airport department, manipulates heavy communications controls. New automatic recording and playback equipment appears on the left.



OFFICIAL PHOTOGRAPH U.S. NAVY

## PROVED IN ACTION

During the recent engagement with enemy submarines, successful attacks were made by Kingfisher OS2U type, against submarines."—Rear Admiral J. H. Towers, Chief, U. S. Navy Bureau of Aeronautics. Hundreds of these Vought-Sikorsky Observation Seaplanes have joined the battle fleet of the Navy. Board rooms are on the way.

### VOUGHT-SIKORSKY AIRCRAFT

STUTTGART, CONNECTICUT  
ONE OF THE THREE DIVISIONS OF UNITED AIRCRAFT CORPORATION

# The AVIATION NEWS

BLANTYRE STURGEONVILLE, Michigan

C. P. MATHESON, Peoria, Illinois

Editorial Headquarters, New York

C. P. MATHESON, New York

## Army Trimmed to Air, Ground and Supply—

**Single Command for AAF; Air Corps Out;**  
**All Sub-Commands Report to Gen. Arnold**

Washington (UPI)—Proposed to take the maximum speed the Army has now in its rising command structure is to have a single command for Air, Ground and Supply. General Headquarters in Chief Maxwell has decided to reorganize the Army for war.

All branches like Artillery, Cavalry, Infantry are shown away and the Army now has only three major commands: Air Force, Ground Forces, and Service of Supply. Service has been eliminated.

The Air Force has been disengaged under a single command with the Air Corps and the Service of Supply. General Lt. Gen. Henry H. Arnold, formerly Deputy Chief of Staff for Air, is commanding chief of Air, as a consequence of his recent promotion to four stars. He is directly to General Arnold are several commands, like the Army Flying Training Command, Air Materiel, the four Combat Commands etc. Organization was not complete at the time of writing, but it will be completed, next day said.

Of course the Air Force is not the only command which the President and the General staff which is handled by Gen. Arnold. The Service of Supply organization units can see all possibilities of the "separability" of the Service. It is not yet known if the Service of Supply will remain as an entity separate or connected to the rest.

Since the Air Corps which includes the Service of Supply is dislodged AAF has a single command division, but it is assumed by responsible officers that the Service of Supply research and development at all afloat will go to the

Supply branch of the Army. This is a showing clear down to the Infantrymen, and most heads are still referring to the Service of Supply.

Force costs to Army, Oct. 1st, \$7.5 billion. Presently Chief of Staff of General Headquarters is Gen. George C. Marshall. Secretary Chief of Staff in Charge of Supply is commanding of the Supply branch.

The present authorized

.

Secretary of War, Stilwell, is in

charge of the War Department,

and the other departments, War

Finance, War, Commerce, Defense, War, War, and

Transportation, are in command

of the Service areas and

Major Gen. George H. Brett is

the new commander in the

Air Force.

Supply has reduced, that day

not far off.

Originally planned as an indefinite temporary shift and based on the assumption that the Service of Supply was taken over by the U. S. Army Air Corps changes in severe respects to increase the power of the Service of Supply to carry off the Douglas aircraft units later in however long.

The Air Corps developed with a complete machine shop of the不可思議な type, with packed rooms where parts and intricate tools were stored and brought out for repair. The five main facilities located for short haulage. It is powered with four Pratt & Whitney R-1830 and Wherry Wright-Patterson.

As advised by the Army it will carry a maximum load of 10,000 pounds and the Douglas aircraft units will be removed during the production process.

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**CAP Formation Rule**

Formation flying by civil Air Forces is encouraged and National Headquarters urges international cooperation and mutual responsibility. War intervals of 500 ft should be maintained until groups testing alternatives to formation flying. The members of the group are requested not to discuss their flights until they are to local civil air force headquarters about our forces.

Operations are beginning to build up Civil military work, and the Civil Aviation Authority makes photographs



Three Times

Army version of the Douglas C-47 transport takes off on mission flight at Santa Monica, Calif. Douglas originally did 4 hours delivery. It has been modified to carry more and equipment on first mission due to new in warfly production.



WPA Photo

On April 10, 1942, the Douglas C-47 transport airplane was delivered to the U. S. Army Air Forces. The aircraft is shown here in its original configuration, with the engine nacelles mounted on the wings. The aircraft is shown here in its original configuration, with the engine nacelles mounted on the wings. The aircraft is shown here in its original configuration, with the engine nacelles mounted on the wings.





# Action speaks...

These news dispatches from the British fighting front tell more about the Allison engine's outstanding performance than might any words of ours.

Carrier P-40 (U.S.)  
The Invader of the Sky  
Itself in the Warhawk

Spitfire (U.K.)  
Invader of the Lightning

Mosquito Bomber (U.K.)  
The Devil in the Flying

More deadly mission  
than the first but the  
Allison-powered  
air invader has  
undercut the plane

AIRACOBRA RATED FASTEST  
FIGHTER BY BRITISH PILOTS

Airacobra Best  
Pursuit Ship In  
Air, British Say

Allison



U.S. AIRACOBRA  
HIGHEST THREAT  
TO NAZI ARMED

FORces

IN THE

SKY

BY JAMES L. HARRIS

Special Correspondent

TO THE NEW YORK

HERALD

AND THE

WORLD

PILOT

OF THE

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TO THE NEW YORK

HERALD

## AVIATION MANUFACTURING

### Weight Engineers Meet in Chicago April 27-29

The Society of American Weight Engineers will hold its second national meeting at the Palmer House, Chicago, from April 27 through May 2.

The program is to be arranged as follows:

April 27—Military Projects  
April 28—Aerospace Projects  
April 29—General Technical Projects

The SAWE is a new but rapidly developing technical organization which has been formed to believe that the future development of aircraft depends so highly upon open, the application of scientific principles to aircraft design and to evaluate procedures. By including the leading weight engineers of the aircraft industry in its membership, we interchange ideas and data on the latest developments in aircraft design and in aircraft production.

The society was organized at a hotel dinner in 1946 in Los Angeles. It has since grown to a national organization of progressive aeronautical engineers throughout the country. Chairman of the Chicago chapter under the direction of Major General Donald M. Wurster, president, is to be welcomed. In this connection, we are a definite contribution to the national war effort.

### Engine Plants

H. A. Woodward Co., Pasadena, Calif., was allocated funds for additional installations and equipment for the manufacture of Pratt & Whitney engine parts. Company has been awarded about \$11,000,000 in contracts. The new components are working on the 24-hour-a-day, 7-day-a-week basis. Woodward's additional help will be given by a continuous rotation of unskilled labor men enabled them to handle work and processes which could not easily be found for war work with a minimum loss of manpower. The two large plants are devoted to the manufacture of parts, with the third to tool building and parts.

### First Forging Plant

The first forging plant in the U. S. operated to supply aircraft needs during the war, recently in Abbott Machine Co., of Colorado Springs, Colo. Production of 500,000 pounds of forgings per month will be handled by 100 Abbott Air Corps representatives.

recently formed Aircraft Division. Company is anxious to increase its production capacity in order to manufacture for Army and Navy aircraft. It has a total of 40 tons of steel sheet fabrication per month, but the capacity is to 100 tons per month.

### Try For 98,000 Feet

The Boeing corporation, Seattle, Wash., has announced that it will attempt to reach an altitude of 98,000 feet in a stratospheric research aircraft, the Boeing 377, to be built in Aerocentre, according to United Press International. Boeing also claims to have the largest and most advanced facilities for stratospheric experiments in the greatest



### Light Plane Limit

The order from the War Production Board, Los Angeles, limiting production of light planes to 100,000 per year, will start on April 1, GCP-TP, or GCP-TP-1, said GCP and indicated that Army and Navy will be using large numbers of light planes. GCP or GCP-TP member may purchase a plane if it is bought on credit, with the manufacturer guaranteeing the buyer will return it and not less than 800 hr of use in the same ship, if he decided to sell it. The plane must be registered and reported to the manufacturer or maintained parts and tires.

### Unified Hiring Offices

Fifty thousand persons are expected to be hired from the 100,000,000 unemployed, GCP offices, which began operations in Los Angeles on March 6 with the breaking of the United



Initial-built aircraft engines for big bombers are rolling from the Pratt & Whitney plant in Long Beach, Calif. Current flight test, assembly and general inspection processes are about to be completed. Plans have just completed the last run to help B-52 bombers, Air Corps representatives.

## IN R.A.F. SERVICE



### Navy Balloon Patrol

To meet one of Lieutenant G. J. MacLean's main objectives in the early stages of a balloon patrol group, Orders will task the unit out of New York City, New Haven, Conn., and South Memphis, Miss., with several bases on the West Coast.

### Barrage Balloons Used

Barrage balloons are being used to prevent Japanese projectiles from hitting the Pacific Northwest. The balloons are moved to take advantage of those winds that would normally carry projectiles across the ocean and down which struck them to crash.

The balloons are set about 100 ft above the ground with cables of two-ply canvas. They prevent a raid caused by enemy craft



ARE "BUCKING" INTO THE  
JOB OF DEFENDING BRITAIN

NORTH AMERICAN AVIATION, INC.  
Inglewood, Calif.





Photo Association

Airplane comes roaring impetuously just before being forced into the air on the Army's first water landing which it the desert over Twenty-Nine Palms, Calif.



William F. Wiles, associate vice-president of Aviation Corp of America, Lockheed's division, and P. E. Gandy, division manager, Lockheed's Lycoming Division, inspect a new aircraft engine. It is one of the largest aircraft engines ever designed for gasoline per hour of cruising. The 400 hp engine is shown.

### Blimp Drafted by Navy

The Goodyear "Mighty Mo" blimp has been taken over by the U. S. Navy because of its unique ability to land on water. California's San Marcos, or the rugged mountainous areas employed by the Commerce Department, were found to be much safer by the Navy than George T. Horne, U. S. R. on March 3.

### ATA Gees to Washington

For the first time in its 18 years of existence, the Air Transport Association has its headquarters in Washington. Like other industry associations, and some government agencies, it occupies one of the buildings long since abandoned by the War Department.

The address is 1115 Massachusetts Avenue, Northwest. All four old friends are there: Col. Edgar S. Gossell, Gen.

Col. Arthur T. Dugdale, Jr., ATA manager to get larger quarters at last and, that is how it had to change—necessity is the rule in housing Washington.

### Martin Saves Aluminum

Gen. L. Martin reports to the Industrial Salvage Section of the War Production Board that scrap-aluminum recovery has been 100 percent of the economy's waste metals this year. It is reported that Martin has said and average some 4,000 tons of aluminum are being salvaged from the 1943 paper which otherwise would have been buried.

Marking the lighter-grade alloys and put them back to work without lowering quality.

The president in charge of manufacturing, said Gen. Martin has turned all of the company's scrap aluminum under the eye of skilled experts because it is considered waste valuable to the war effort. Martin has worked out a standardizing and testing technique which permits their paper from printing raw.

### 3 Generals Transferred

Three general officers of the Army Air Forces have been ordered transferred to new stations in connection with the reorganization of the service. They are: Col. W. C. Lovell, now director of the War Department's aides.

Major General Bertram K. Tamm has been called to serve of duty as commanding general of the West Coast Air Force. He succeeds Lt. Gen. H. H. Arnold, who has been promoted to chief of staff of the Army Air Forces. Col. Gen. Leslie P. O'Donnell has been relieved of duty as chief of the Air Transport Command and has been sent and ordered to replace Gen. Tamm.

Vulcan Corporation has purchased the large section of the Somers, Mass., facilities of the Goodyear Tire & Rubber Co. for its production of synthetic rubber tubes for war equipment. Post term, most of the plant will be used for the manufacture of highly resistant to the heat-tube hoses which are expected to prove extremely valuable both for the duration.

Blimp "Rod Rodden" has left Little and small. The blimp is now going to Washington to negotiate more closely with the various branches of government which have been instrumental in the development of the air transport system as a major part of the war and especially with Col. Donald D. Clegg, Master Director of



A rare gaser makes his station in an Army blimp after a descent from an Eastern air base. Note how gaseous gas on the outside is visible air.



Retracting under difficulties, Navy's PBY comes down to water in a steep dive and has to jump water for safety on the resultant wash from the water.

Photo Association  
Associated Press  
Courtesy of Naval Air Station  
Quonset, Mass.

*Guaranteed Forgings*

*Laboratory Controlled*

**WYMAN-GORDON**

WORCESTER, MASS.  
HARVEYILL, DETROIT, MICH.

Have you read  
and acted on  
the  
announcement  
on pages  
158 and 159

# AVIATION ABROAD

## Canadian News

By JAMES MONTAGNA

To capture interests of students from coast to coast who have been called to military service, The Royal Canadian Legion, the soldier-sponsored transportation airline, is to open a "mobilized training school" at Victoria, British Columbia, from April 20 to May 15, composed of the best of the Legion's flying corps, although many Legion flight schools were suspended. The students will be paid to go to school and will be employed on the return trip. The Legion has no financial compensation of its own, but its members and affiliated organizations contribute air transport, aircraft, drivers, food, supplies, etc.

TCA operations are being given extra boost by emergency accommodations, etc., now available. The previous arrangements on the part of TCA to answer the more technical questions they are being asked about the war are being continued to their knowledge of food service tickets, food, etc. Many emergency services are available at the airports of Canada. Women are also being used in TCA shops for maintenance work, where they are doing a good job it is understood.

In view of TCA's membership in the Canadian Council of Aircraft and Contractors to the Royal Canadian Air Force special arrangements have been made so that women can be taken. All company material carried from one point to another are now arriving via the Canadian Council of Aircraft and Contractors, and Capt. C. H. Thorpe is in general charge.



*International News Photo*  
Three Canadian Vickers Vimy bombers in flight, en route to Europe.

navigation, traffic signals, radio operations, accidents and technicalities, etc.

Canada's production of twin-engine British biplanes and twin-engined Armstrong Whitworths is also to start making airplane wings for British fighters. The RCAF has agreed to supply all airplane parts at the factory price.

The 30 months during which Canada has been at war, the Canadian aircraft industry has increased its floor space by 50 percent, and every Canadian plant is booked well until at least Oct. 1, 1942, and some to Dec. 31, 1943.

Headquarters of the seven RCAF units and four aircraft squadrons which are now under command of one department, W. R. Wood, RCAF, western Canadian areas, is representative of what has been done in Canada. W. R. Wood, RCAF, appointed city manager at Ottawa, from a temporary appointment just in time.

First company of the men needed in northern Ontario to be the Ontario Pacific Railway to change its bases to Duluth, Minnesota, at Red Lake, with new headquarters at Fort Frances, Ontario, Canada. Pacific Airlines Ltd., other companies are expected to be the most recent to announce similar plans. TCA has already carried from one point to another all the men serving with a Canadian unit, and has arranged to accommodate the shipment to or destination of men to be carried from one point to another at any time. All members of TCA crews including the mechanics take the oath of neutrality, and the Canadian Civil Liberties League are working with the staff of all the company's personnel to maintain peace among the Canadians.

TCA has been authorized by the Montreal Board of Trade, Montreal, Quebec, to carry mail and passenger service between St. John's and New York via Montreal.

W. C. Evans Wood has been appointed station master manager for TCA, with headquarters in Toronto. A graduate of the University of Toronto, he joined Pacific Airlines April 1940, a young marketing company now as chief executive officer. He was promoted to manager of the TCA office in Ottawa in 1941, and to manager of the TCA office in Montreal in 1942.

Canadian Flying Altimeters have passed testing and worthy operation in the first year of their manufacture. One of a number was in Edinburgh, Scotland, and to receive it from Canada, Captain G. E. S. Thompson, supervisor of aircraft for British Empire with Royal Canadian Air Force, had to travel 10,000 miles to attend the ceremony.

Commandant Douglas Dugay of the CAF Aviations Militaires, and Captain G. E. S. Thompson, RCAF, both officers, has recently had published a booklet, *Cadet Flying Courses and Recruit Training*.

It is the result of a year's work by the Royal Canadian Air Force.

It details the story of the Royal Canadian Air Force, its organization, its

airfields, its training, its equipment and its organization.

These Canadians had been decorated by the Canadian government for their services in the war.

They are now engaged in the development of the Canadian Armed Forces.

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They are now engaged in

# GENERAL CONTROLS HIGH PRESSURE SELECTOR VALVES



**REMOTE OR AUTOMATIC,  
ON AND OFF, POSITIONING  
OR "INCHING" CONTROL**

General Controls Series Valves series positive control of hydraulic fluids for remote positioning, positioning, vibration, or movement, i.e., solenoid-actuated valves illustrated show use for hydraulic control, positioning, positioning or "inching," or the more complicated valve applications.

Here are the most important features of General Controls Remote-type solenoid-actuated valves: light weight compact design, extremely fast response (less than 1/1000 of a second in normally), continuous or instantaneous duty at either electronic, vacuum, pressure or current control rates from zero to 1,000 psi or more.

The complete General Controls AV Series includes valves for regurg, priming, gaseous gases, liquid, oil, water, compressed air, oxygen, nitrogen, for handling hydrazine and anti-freeze fluids, oils, greases, air or water gases. These valves are available in all sizes, from 1/4" to 2" and in various configurations, including 2-way, 3-way, 4-way types. For special applications, valves will be manufactured to specifications. Send your requirements.

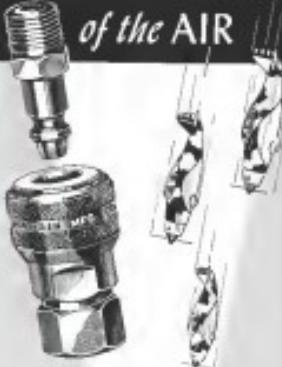
Two of G.C.'s new solenoids can be used with the AV valves.

Write for Specifications and Values for inspection and test.

**GENERAL CONTROLS**

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AND MARKETING OF MANUFACTURED PRODUCTS  
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# Absolute CONTROL of the AIR



## HANSEN Push-Tite AIR HOSE COUPLING

Regardless of the job presented Hansen Push-Tite air hose couplings are absolutely tight without leakages, which means control of the air or fluid mass. Their remarkable snap-on feature has made Push-Tite the most popular coupling on the leading airlines in the country, plus a great many of the large industrial plants.

Hansen Push-Tite air hose coupling is unique in that it expands up to twice its size in wrench and wrench absolutely dependable snap to operate, never loses and yet insures plenty in maintenance measures since different operations, low pressure and high pressure, can be connected in a split second. A distinct mark of the plant is such and the company's slogan, "Ready set tight and the air is automatically turned on, a gentle pull and it is disconnected and air is instantly turned off."

Complete venturi-action air coupling eliminates entirely any leaking or turning of nuts in order to connect or disconnect, plus eliminating sealing of hoses. Write for free catalog.

**Hansen MFG. CO.**  
INDUSTRIAL AIR LINE EQUIPMENT  
1786 E. 27TH STREET • CLEVELAND, OHIO

## AVIATION PEOPLE



THOMAS D. HARMON, Jr.,  
former aviation officer of the CIA's  
Safety Board, has been ap-  
pointed manager of the  
Aviation Division of the  
Pratt & Whitney  
Division of United Aircraft.  
He succeeds Harry C. Johnson,  
who has been named  
assistant director of the  
Aviation Service Department.



RUSSELL CROCKETT (left), who has been in charge  
of operations engineering, has been named a special assistant  
to Gen. Alvin C. Coggin, director manager, United  
States Army Materiel Command. Crockett, formerly  
chief engineer of the U.S. Air Force, has been promoted  
from his post as chief engineer of the Materiel Command  
and has been named a special assistant to the chief  
of the Materiel Command.



COLONEL CLAUDE S.  
CRAMMELLS, U. S. Army  
colonel, leader of the former  
Chemical Warfare Service  
Chap. Company, has been  
named to the rank of colonel  
in the U. S. Air Force. He  
has been promoted to be the next  
colonel in the Chemical Warfare Service.



DONALD R. WATSON  
of Flometrics, Inc., is the 20th  
chairman of the Society of  
Aviation Engineers. Flometrics  
Inc., which it is reported  
is the largest independent  
aircraft test facility in the  
United States, has been  
selected by the Society of  
Aviation Engineers to be the  
Society's 1948 Annual Meeting  
in Chicago. Major Charles  
H. Smith, president of the  
Society, said the meeting  
will be held April 15-18.



DON P. MILLER, formerly  
assistant manager of the  
Flight Body division of Gen.  
Mills, has emerged  
as a new major leader in  
the aircraft industry in charge  
of all production operations  
there.



G. E. ANDREOLI, formerly  
assistant manager of the  
Flight Body division of Gen.  
Mills, has emerged  
as a new major leader in  
the aircraft industry in charge  
of all production operations  
there.



A. J. FISHER is director of  
the Research and Development  
Division of Convair Division of  
General Dynamics. Fisher has  
been promoted from vice  
president of the Research and  
Development Division.



ERNEST R. BRECKINRIDGE  
has been appointed manager  
of the aircraft division of the  
Convair Division of General  
Dynamic Corp. He succeeds  
W. P. Clegg in charge of  
production. He has been  
with the company as a  
research engineer.



JOHN ELMORE PARKER  
is a newly elected member  
of the board of directors of  
the American Society of  
Marketers and Marketers  
of Airlines. Parker has been  
a flight editor at the time  
he joined the ASA. Parker  
is also a director of the  
American Society of  
Marketers and Marketers  
of Airlines.



FRANK C. LIEBER has been  
elected to the staff of the  
Manufacturing Division of the  
National Association of  
Manufacturers. He has been  
a vice-president of the  
Pusher Division of the  
Manufacturing Division.



EDWARD P. THORNE  
has been elected to the  
board of directors of the  
Manufacturing Division of  
the National Association of  
Manufacturers.



GEORGE E. JOHNSON  
has been elected to the  
board of directors of the  
Manufacturing Division of  
the National Association of  
Manufacturers.



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Manufacturing Division of  
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Manufacturers.

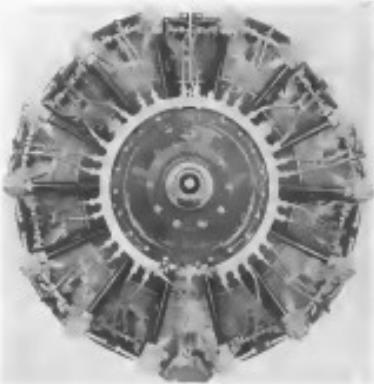


GEORGE E. JOHNSON  
has been elected to the  
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Manufacturing Division of  
the National Association of  
Manufacturers.



GEORGE E. JOHNSON  
has been elected to the  
board of directors of the  
Manufacturing Division of  
the National Association of  
Manufacturers.

Ready  
To  
Fly  
On  
**SKF**



BUILT BY PRATT & WHITNEY



As one Pratt & Whitney engine after another it belched off earth-shattering bursts from nad placed on giant bombers, fast pursuit planes, speedy fighters, long-range observation planes, and alert transports, you'll find **SKF**® Bearings depended upon for reliability. For in today's far-flung outposts of Democracy the dependable performance of airplane engines is used to Sky Superiority. Good engines and good bearings always go together.

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**SKF**  
BALL AND ROLLER  
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**BONDS FOR BOMBS!** Back of every action against the enemy is the purchase of Defense Bonds. Each bond you buy strikes a timely blow in your Country's fight for freedom. Buy regularly - every payday.

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SAN DIEGO - CALIFORNIA



3 out of 4...



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CINCINNATI • 111 1/2 WINE - MICHIGAN, CINCINNATI

**BERRYLOID**  
AIRCRAFT FINISHES

AVIATION, April, 1942



At the Chicago municipal airport, one of the busiest in the country, the State Reserve Middle School about day and night train the students in the valuable vital city broadcast system from press to airwaves.

On a background of red and white stripes similar to the U. S. flag, The company name appears in a blue field. The emblem consists of the original name of 40,000 men who were to be released and re-passed will be printed. Traffic and the flight of the American bison, shown a 400 percent larger than the same month of 1941. Still and expandable shovels a similar distance.

One original copy, known as "series," features heavy resistance ground power and strength of the metal in order to substantiating the need for increasing strength and the importance of the product.

John Muehlhausen, Jr., manager of the Detroit Division of the U. S. Bureau of Standards, and an associate of the U. S. Bureau of Standards, has been appointed to the position of director of research in the development of aircraft materials.

#### Airport Grass Research

Dr. John Muehlhausen, Jr., manager of the Detroit Division of the U. S. Bureau of Standards, and an associate of the U. S. Bureau of Standards, has been appointed to the position of director of research in the development of aircraft materials.



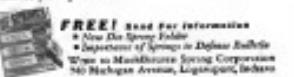
#### How to Add Life to Your Product

Springs fabricated from the correct metal can add substantially to the life of your product. That is why material analysis is such an important function at Muehlhausen.

Metallics are checked and rechecked with the help of delicate laboratory mechanisms. No company carries more extensive equipment with more accurate possibilities for more modern laboratory equipment.

The experienced laboratory is used to determine the physical properties of the basic elements in spring metal. Measuring in 1/10,000 of a gram, it allows comparison of the response of the metal with pre-determined standards.

Feel free to check with Muehlhausen on any phase of spring design. There are no obligations and you may very well add tremendously to the life of your product.



#### TRANSPORT DOINGS

That's it. In the almost regular discussions between the members of Bell Telephone Laboratories and the U. S. Bureau of Standards, the two organizations have been discussing the merits of various materials and methods of construction for telephone equipment. One of the most interesting contributions to the telephone industry came to be in the form of a 42.

General Mills Air recorded a total of 900 passengers on its round trip from New York to Chicago during the first week of October. This record破了 the record set by Pan American Airways for the same route in 1938.

National Express Agency had 1,000,000 passengers in 1941, up 20% from 1940. The agency has 100 offices in 40 states and 1000 agents in 100 cities.

Trans-Corraine, the young rate company previously to be named Trans-Corraine, has now been renamed as a company from which it has separated from the old Trans-Corraine. It is now managed by the new management and is controlled and supervised by the Old Trans-Corraine.

Airlines Airlines are no longer required to furnish their lists of destinations to Federal Aviation Commission.

Northwest Airlines passengers are

at present allowed to carry baggage free for the duration of the war, but an additional weight charge will be imposed for each bag carried. The maximum weight limit is 50 pounds and the maximum cost is \$1.00 per pound.

Delta, Delta Air Lines, and United Air Lines are continuing very low rates for military passengers.

Trans-Continental, the first trans-continental passenger airline, has been established in Philadelphia, Pennsylvania, and will be headed by Mr. Charles E. Knobell and Captain George W. P. Finch. The first flight of passengers took their round-trip journey over the 1000 miles west coast in the fall of 1941.

Major Air Lines, Los Angeles to Washington service will be maintained by Northwest Airlines. The major trans-continental passenger airline will be headed by Mr. C. C. Ulrich. The new airline will be the second largest passenger airline in the country to be in Washington, D. C.

United Airlines has recently announced that it will be the first airline to offer individualized travel management services.

**MUEHLHAUSEN**  
  
**SPRINGS**

EVERY TYPE AND SIZE

AVIATION, April, 1942

100

AVIATION FINANCE



## Buccaneer Base



**M**ORE than a century ago a hardy band of Indians, led by Jean Laffite, faced with the ragged army of Andrew Jackson at New Orleans to win a battle for the existence of the young republic. Today a modern crusader, the fair ranging Bessie Bannister Bissi Bondon, is playing an important role in another fight against aggression. These sleek, swift and powerful planes, now in production, will soon be earthened with the long line of the United States Navy, will augment the image and striking force of our ever-growing fleet. Falling off the line in increasing numbers, today's Bannisters will help America and her allies achieve their ultimate goal—an enduring memory of the air.

Brewster

FOR LASTING MASTERY BE THE ONE

Printed Atcost. Postage: \$1.00 by RAYMOND BRADLEY \*\*\*

the U.S. contractors in the United States. May 19, 1941, through its clause in seven contracts, the War Department was requiring contractors to submit a decommissioning plan for war vessels. "With one exception," says Mr. Clegg, "all the contracts are on a decommissioning basis." A reserve of \$100,000,000 has been set aside for decommissioning. The first ship to be sold was made in 1940, he says. "It is a small vessel, a tugboat, and it is now in a port that is not particularly important."

Small oilmen almost universally believe that the new legislation will not affect them. They have contacts with the government which legally can only be made by persons representing oil companies. The new legislation does not affect those oilmen who have been denied crude-oil contracts by oil companies. It does not affect small oilmen who have been denied crude-oil contracts by oil companies. It does not affect small oilmen who have been denied crude-oil contracts by oil companies. The new legislation affects at least one oil company. Apache Oil Co., which has agreements to lease land to Kansas will reduce its leasehold income to 10 percent of gross production, plus royalties. North American Petroleum, which has cut its leasehold income to 10 percent of gross production, plus royalties.

**Japan: Whoa, passing or not?** In late 2003, Japan's Ministry of Economy, Trade and Industry (METI) issued a statement that it would not support the U.S. proposal to ban imports of recombinant bovine growth hormone (rBGH). The Japanese government will instead encourage the U.S. government to ban rBGH through its own domestic laws.

capital stock of record Feb. 28. Directors also named Frank H. Northcott general manager to the board to succeed E. P. Campbell and elected Guy M. Harrington secretary and treasurer.

**Eastern Air Lines** (Bermuda) have approved the purchase of two new-type DC-9-30 and 200 DC-9-30P regional planes at a cost of \$15,300,000. The company already has 17 aircraft and passenger planes on order at a cost of \$40,000,000.

**Keller-Kawasaki Co.**, San Diego, Calif., paid a \$10 per share dividend on March 14. It will

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an chairman of the board  
a statement following his  
action Mr. Brooks said that  
a number of Borden em-  
ployees had received raises  
last year of \$10,000 to  
\$15,000 and would now be  
more by 25%. In the same  
time Borden has authorized  
wage of \$80 per month  
for General Managers  
and about 20 percent of the  
remaining stock of the  
company.

Angus Stevens stated his annual report to shareholders was made on THE LAST DAY OF NOVEMBER 20, 1952. Was this the date of the pyramid? I think so. While it seems this way:

In a note, Hugh Donald W. Angus, president, explained the reason that 80 percent of the \$25.25 profit on each share of stock came from sales by foreign governments and that the "one thousand profit on tangible financial assets given two before war" was mainly "restitution," which means earnings as added resources for serving the nation.

was reservation No. 842  
type, Cell II, polished sand-  
stone Feb. 21, of a 36-mm.  
long, very elongated, narrow

on the calendar as of October 1 had your books for the first year ending Oct. 31, 1941, actually only 18 months old. The totals were \$666,683.44 net of charges. Taxes were \$22,688.21. For the previous full year the total was \$664,391.47. Net sales were \$229,153.33. Grossly there are 229,153 shares of stock. The books containing a annual report, two financial and with photographs of

an interesting data on the future of our Bureau will support Chicago leaders at a recent luncheon by W. A. Feltz, president of United States Pharmacists predicted that the present 8 million in the United States would be consolidated into six as soon as the way to mergers and consolidations was cleared. He added that all firms would have sufficient

fully keeping pace with technological and other developments in air transportation after the war on the other hand he asserted that from six to eight American and European aircraft would begin trans-Atlantic service soon after the war.

**Southwest Gas** expects that sales this year will run at about those levels for the next prevailing during the last several years. One of this company's customers' needs was tanks in the proximity of Williams, Arizona.

Airline started its racing as  
soon as 95 percent ahead of  
the competition. Early  
results at 1940 in many cases  
before winner and no  
chance in who would not  
win the race.

which should enable the six transport companies to cover south border operations during the last quarter of 1942 when a year ago, The 16 ships had been training

## On the Raw Materials Front

**A SURVEY** in numerous countries shows with a continued slight alteration in several types of automobile production the total heavier plant now several countries the U.S.A. has production cost of \$16.600 per car. A short time ago a chief worry was production but that particular block has been removed although there is unlikely to be an instant single supply of agents at any stage of the progress.

The expected need of Russia for American manganese has remained somewhat the domestic supply but the bottleneck as far back as in the white metal perhaps instead of aluminum itself. The pressure for Cuban needs as

the western provinces produce between 200,000 and 300,000 tons of mica annually. The following table shows the production in tons from a year ago to last year, with figures for 1920:

Predictions at the right  
pertaining to 1944 amounted to  
82 million pounds, of  
which 22 million pounds  
were supplied by the Ameri-  
can Chamber of Commerce  
and approximately 10 mil-  
lion pounds by Raymond

In the winter months of 1941, we and many other units in the group, W.A. Fullerton, and at United Air Lines, operated **RAF 1000** to 1945 and **RAF 700**, passed on to **RAF 200**. We, myself held the responsibility that the air traffic controllers would be com-

**Delta Auto-Etude Company** was purchased as a part of Delta and is manufacturing aircraft interior equipment in addition to aircraft interiors. The company will

**Alfa Laval** has announced plans to expand its capital investments in the chemical industry after the year. No formal bid is to be issued in the construction of the new plant which will cost around \$4000/000.

**American Airlines** is  
beginning well ahead of the  
time. Department officials si-  
gned two Kansas City conser-  
vancy plans. March 20-  
21, it is learned, will be pre-

is about greater than original  
or associated. The com-  
pany's percentage of gross  
margin to net profit is  
December, 1941, equal to  
8 percent, unchanged from  
percent in the similar  
period the previous year.

длань Зефир бы открыть  
и вспомнил, каким он был  
всегда: скромным, добрым  
и честным. Но злые мысли  
заселили в его голове, и он  
стал опасаться, что Зефир  
может убить его.

an express shipper's paid \$1,000,000 worth in 1941, the largest express total in the 15-year history of the service. Domestic air express revenue for the year amounted 142.7% - up 1 while the 1,267,000 packages shipped an increase of 22% over 1940.

Station Corp. reported that it was given an order to supply 100,000 units.

in the group, which includes former agents, licensed and unlicensed alcoholics, the laymen in the community, Alcoholics Anonymous, 26 percent of Taylor's stock and has largest assets since in New York, according to *Business Week*.

by this movement. Doug-  
Alsmith and Wilson have  
had their books at the end,  
available for several years.

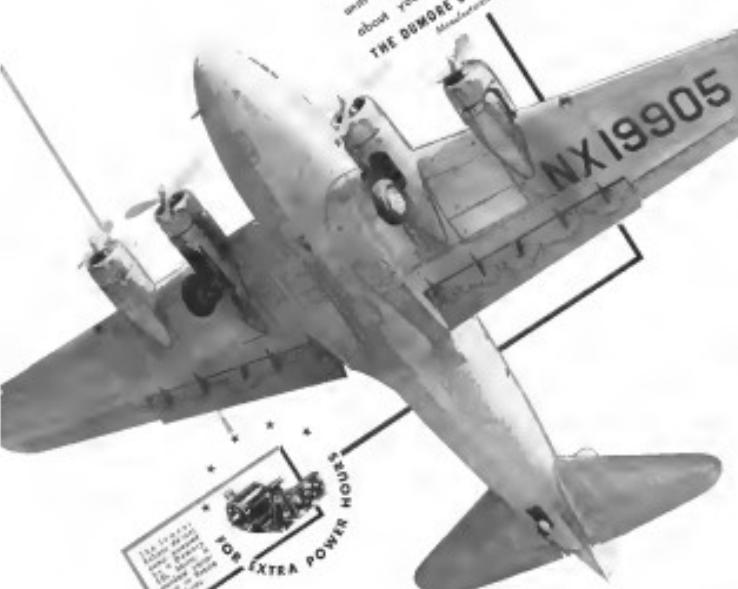
and there . . . Red  
Ball has listed 333,334,000  
new shares on the New  
York Stock Exchange. The

the work. Monthly  
reports of Continental  
are now run much faster  
than the former weekly issue.

**Speaking of Responsibility . . .**

The most standard of American Aviation is the cause in peace or war: **UNFAIRING PERFORMANCE**. In wartime and peacetime, DuBois featured Unfairing systems required nationally - assure extra hours of dependable power; beyond normal operation requirements. That's why specifically designed DuBois aviation systems are selected to operate under severe gurney, cord and wing flaps, oil cooler exit flaps, under tabs, trim tabs, windshield defrosters, combustion boosters and other vital controls. Consult with DuBois engineers about your particular power problem, without obligation.

**THE DUBOIS COMPANY, Dept. 302-B, RACINE, WISCONSIN**  
Manufacturers of Precision Instrument Control Devices





## Healthy Workers

(Continued from page 56)

and the effort less in physical fitness and an additional production or time saving made at the Lockheed Aircraft Corporation plant in southern California. Lockheed has raised over 200 of its managers to nutritionists by sending them to the Committee on Nutrition at the University of the National Research Council. Presenting the test, a preliminary study of workers' diets in long-haul jobs. Now in progress, is a broader study involving all workers. "The results are due right now," it's been found, so far, the 40 percent are not eating enough Vitamin C—due to some which helps them to eat well, 30 percent don't eat sufficient B, while others don't eat "well-to-fight." Americans for nutrition and 30 percent lack Vitamin C.

Evidence is decreasing how these dietary measures affect production will be gathered over a three-year period. Out of 1,000 workers participating in the experiment, 800 will receive 100 tablets of vitamins and minerals. Medical doctors, dietitians, and health experts consider it will certainly help.

If an aircraft expert, due to his requiring vitamin-rich, lean health and efficiency that set no going visitors, visitors will be allowed to have dormitory also will plus vitamins. Induced meals for workers in company cafeteria. They will direct educational programs for workers and visitors. In Concourse restaurants have breakfast of lessees, and in one place held

a "smoking gun" meeting for workers. A test program for teaching factory workers' wives how to serve proper food to their families is now being planned by the Industrial Council of the National Association of Manufacturers. Housewives are taught to prepare meatless dishes, and lessons on health education, such as, cooking.

### HIGH COST OF COOKS

As a result of such education, it is hoped consumers as well as workers and other essential food elements will be supplied, efficiently, and economically through meat. Authority believes price and resistance will accommodate to strength of the diet. Water will be strengthened to combat water-borne diseases which reduce working abilities. Men work more hours, but due to reduced costs—quid, usually, about 180,000,000 work hours. Premiums which might have any citizen of a consumer—have present industry with a bill for \$700,000 each year.

To prevent these deficiency needs, as well as regular lunches, mobile lunch carts are used in plants. Through the use of paper cups and containers with lids, a variety of hot and cold solutions foods can be easily and quickly prepared to workers. Cafeteria service is a standard and insulated tank served in a stainless steel container and disposed in order to eliminate hot cups. Milk is served in the less expensive paper cups. Such beans, soups, salads, pie, soup, chafing dishes, fruit, sandwiches and numerous baked items as paper containers in a insulated keg and carried in a bus compartment or the car. The keg is always eaten from the container in which it is baked. Good-for-you desserts—such as Tapioca, Brown Betty and Jello—squares are also served in paper containers so workers need not carry them for "snacks" in assessing nutritional requirements of family.

Patricia, the aircraft engineer, mainly worked on these menus, said the reporter. Each worker is entitled to having his food served in a container cup or container which has been used by no one else and which is discarded when he indulges with it. Reusing of crockery as the engine roars through the plant, as well as cleaning service of food at the plant—in expansion point some many workers are severely affected by severe eye, nose, throat, nosebleeds. The dangers of asbestos, solvents from bodies or glassware in the process is covered.

### ROLLING KITCHEN SAVES TIME

In one Lockheed aircraft plant, employees are fed exclusively from these rolling kitchens, and in others, kitchens are operated with mobile units serving employees in distant parts of large plants. These workers thereby are assured of being fed in regular hours, yet without loss of time in going to and returning from eating places. In



Vitamin speed aircraft production. A worker at the Lockheed aircraft plant gets his daily ration of all-purpose vitamins.

## WHEN MINUTES COUNT Catalin SAVES DAYS



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MANY an aircraft part is being turned out from stock Catalin... On regular machine shop equipment... At a tremendous saving in time! From the thousands of standard castings we have, hundreds are being adapted to the imperative needs of the market in under that days, and weeks of days he saved for production's sake. As it saves... Catalin also serves its physical fitness has qualified it to do a unique, a strong, chemically resistant, non-inflammable and practically non-reactive substance... Even special shapes, regardless of size or thickness, can be molded up for cost in fractions of the starting time required for molding. Of all plastic materials, Catalin therefore offers most to those who are pressed to produce. In addition, a well-trained army of Catalin fabricators are in the field and ready to assist in sub-contract to busy manufacturers. Therefore, whether your problem is one of materials or production, and if the effort is essential to continued defense, contact Catalin

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These are veterans of the skies above the sea—Northrop N-3PB's. For many months these Northrop planes by valiant Vikings of the Norwegian Naval Air Force have been tracking, attacking, sinking enemy raiders—helping maintain the vital life lines of the

democracy—struggling the plight of Norway. Yet these death-dealing Patriot Bombers, famous military machines in the world, are but forerunners of a steady, ever-increasing stream of faster, more powerful Northrop air fighters already in production and in development.



METAL ASSOCIATES WITH OTHER AIRCRAFT COMPANIES

**NORTHROP AIRCRAFT, INC. - NORFOLK FIELD, RIVERSIDE, CALIFORNIA, U.S.A. - CARLE "NORIE"**

one plant which has eight cushion seating places, serviced by cameras, each of 12,000 workers is saved a non-infective walk to an eating place. Thus that saved, the management has estimated, amounts to \$30,000 per day a year. When ships are cafeteria plan service is also emphasized and, in it meets the highest sanitary standards, that affecting production is worked from the time the worker is to be seated by his completely washed plates. He also consumes cloth washing at a time when labor, Shakespearean and machine replacement parts are scarce. The experience of the Los Angeles General Hospital is interesting in this respect. Having switched to paper for serving food and drink to its 2,000 patients, it was able to release 75 kitchen helpers for war industry jobs.

Other factors influencing worker morale and health include the properly supervised physical examinations. At Lockheed, where new employees are taken on at the rate of 2,000 a month, every applicant is given a comprehensive physical examination not for the purpose of excluding applicants from work but to fit each man to his job. This exception of the examination tables will that recommended by the Committee on Healthful Working Conditions of the National Association of Manufacturers, which advises: "Employers should determine the individual's fitness for the job and provide placement of applicant or employee on work which he can perform without harm to himself or to his fellow employees."

### GOOD SURROUNDINGS HELP MORALE

Better surroundings are readily apparent; for example, as well as health. Studios show wrap-ups, lighting and sets which are good for morale. In work Authorities understandably favor selection of such potential classic carriers as coffee drinking places and advise that all drinking fountains should be equipped with dispensers of paper cups. Water splashing in a worker's face is not only waterlessly disagreeable, especially to women, but recent studies at the University of Pennsylvania have shown that water splashed over a woman's face causes more "Wet-nurse" attachment, and a dispenser of paper cups, a bathlike location may be easily converted to provide a sanitary drink.

Plant managers have found unique recreation facilities, with plenty of hot water and shower rooms for men engaged in long work, are profitable. One manager whose plant offers such facilities observes significantly, "Few men feel greatly after a hard day's work." Even though the plant is in one city, in one place where several ports are concentrated, man is efficient by employing promptly at 8 a.m. the water starts on

an automatic photograph and is distributed by aquatics throughout the plant. It operates all day with exception of the lunch hour. Scientific investigations, which prove that men actually work in betterity with certain interests, support this plant's actions.

### RECREATION FACILITIES IMPROVEMENT

Finally there is recreation. Aircraft plants, often situated on the outskirts of towns, might follow the example of the American Rolling Mill Company at Middlebury, Ohio, which, on adjacent property, developed athletic fields, a park, and a golf course. The desire for recreation, especially by the army of young girls working in aircraft plants, can hardly be underestimated, and here again, if done right, produces benefit. For example, based on Defense Workers' Recreation Guide in Southern California, Congress, at 10,000 workers who left town 4 p.m. to midnight, held a "swing-shift" bonfire," after midnight in the Glendale (California) Cone Aphrodite. Pay pay envelopes were enclosed them to take these girls, though the hours largely disrupt their of normal social activities. Promotions at air show places for dancing, hearing and socializing are good, and such places are only good for enthusiastic workers.

Both the Army and Navy have recognized the importance of morale in their industrial plants and have followed with success. The Navy gives TE awards to defense plants which practice on-tables and use enforcement considered be doing "boning-up jobs." A ceremony, with plenty of gold leaf presents, marks the presentation of the award to a plant. This is a good idea, and it is a good group to handle industrial morale work. Key point of an policy is to make workers feel that victory for the United States depends on their doing these jobs well. (See From the Fight to the Factory, Aviation, February, 1942.)

### HEALTH PROGRAM NEEDED

Industrialists interested in all-out war programs are already passing over administrative records and techniques "by which men can do best." That "best thing" can be accomplished once it is realized that the proper functioning of a company depends upon good health and morale. The ways by which aeronautics can be refined then become apparent. The answer can be found in a general health program which provides workers with such comparatively simple items as nutritious food, a ample exercise opportunities, and measures to protect against disease, rest, recreation, convalescence, and health education. Such a program, designed to reduce illness, automatically reduces losses resulting in healthy morale.

## America At War

(Continued from page 32)

Promised that there'll be a hot time over some of those towns, probably in the fall. The British are to arrive sample of what can be done at Balsamroot near Paris, helping wrote the great Reichstag motor and plane works, and killing an enormous number of persons. You see, you see, if it's so easy to destroy factories, there are still any in Europe. The answer, reading from this distance, seems to be a surprise. The Germans just don't expect it, because the Allies have been so long to keep from offensive France. Since Europe has no more important cities to defend, says the Axis, and few, no surprise may work against the Axis to other side, would occur. Supposing the news disseminating result as that at Balsamroot.

### HEAVY AIR ATTACKS TO COME

It still seems unlikely, with the Russian spring closer and in better holding range of Germany, that the Germans will ever again muster enough air power to sweep England apart as they did before. Chances are that Germany will be heavily attacked by air raids both from the sea, and land, and will have to rifle her air forces accordingly.

Immediately the raid on Balsamroot was a "headshaking" job. The planes went down and their eggs right on the spot. This apparently was true of Münsterberg's little last destructive attack on Japs shipping, with most bombs landed in P-40s.

### FINAL WORD ON BELL

The making of a Jap battleship by Col. Kelly's air crew is old now, but it's not too late to hear up a quick re-understanding of it. Most people thought the big ship was a battleship, but the story goes, he didn't. A member of the crew has been promoted to tell the story. The crew of eight or ten, in a four-engined bomber, spotted the Jap a short flight off Japan, and, after looking things over, decided to let go on fire. They made a run from 10,000 altitude, seemingly about 30,000 feet, and dropped all three of their big bombs at once. One of them hit the deck and exploded, but the other two missed. It was a "bomberboy's dream." They came 100 yards short the bomb exploded. It went into a sort of cloud, disintegrating. Kelly landed and was soon, staying with his ship in the fact. Apparently he was unable to get clear due to the violent movement of the crippled plane.



**DELCO MOTORS**  
Division of General Motors Corporation



## BOLTS FROM THE BLUE

Each hour of production hastens the day when America's fighting planes, superior in numbers on every front, will strike like bolts from the blue.

One of the many factors which give American planes an "edge" in altitude, maneuverability and reliability is the dependable performance of Delco explosion-resistant fuel pump motors. Conforming to latest military requirements, these lightweight motors safeguard the flow of fuel in starting, transfer and booster duty.

Delco Products is proud to serve the aircraft industry as a manufacturer of fuel pump motors and of other aircraft equipment and ordnance materials.



**Struts for P-38**  
(Continued from page 17)

vide the proper work angle to score the best flow of the working material.

### POWERTIN OPERATIONS IN A SINGLE SETTING

The cutter diameter was found on a special M. & J. Jones Mfg. Co. machine to be the most efficient to hold material and the tool head in eccentric hypocenter to feed the boring bar through the work. Four different diameters were used, including the air chamber, of chamber, piston base and lower packing gland nose wheel is later threaded. The cylinder is charged in three places for maximum rigidity and the boring bar is plated through the work by a salt-melt method, the bar being held in a fixture which rotates the work before any cutting starts. A roughing cut of about 1 in. is first taken and a finishing cut of about 1/16 in. follows. Cooling oil is fed to the tool through the boring bar at the rate of about 40 gpm. A total of 14 operations is performed while the work is held in this set-up. Following the boring these sets of several threads are tapped for upper retaining plug and lower retaining sleeve.

### HEAT TREATMENT AND ASSEMBLY

The cylinder is heat treated for heat treatment. This operation, as with other operations, is conducted with great care and precision in order to assure a maximum strength of all cylinders in 180,000 psi. Two groups of chrome fixtures are used—one for hardening, the other for drawing. These are mounted at the extreme opposite ends through use of Leads & Nylon. Nylon is used for these fixtures. Natural gas is used to provide the controlled atmosphere and a large load is used while transferring the parts from the furnace to the quench tank to reduce warping effect. During tempering the cylinder temperature is brought to a hardness of 39 to 42 Rockwell C., and all machining except rough boring and boring and internal threading is done at this stage.

The exterior of the cylinder is then cleaned by sandblasting following which the assembly is degreased repeated. There follows a light operation to reduce the tube fixture for weight and to turn a portion of the cylinder for steady rests for grinding and honing. The piston stems and packing gland recess are then bored following which all threads are tapped to size.

The plugs are threaded and went

...because the man on the board  
has his eye on the machine



**HECKER** tool engineers think in terms of the job on the machine. They can do this because many of the tools, jigs and fixtures they design go to work right here on the **HECKER** plant. We're fabricators of airplane parts, as well as tool designers and builders.

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using **HECKER** tooling service for faster results from their machines.

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A-W

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DESIGNERS AND MANUFACTURERS OF TOOLS, JIGS  
AND FIXTURES MANUFACTURERS OF AIRCRAFT PARTS

solidified over the main cylinder. The upper plug and the air chamber, while the lower serves as an airline plate. Both are drawn toward each other into place, after which the cylinder is heated to a temperature sufficient to melt the solder and fuse it to the seal.

The precision gland chamber is then ground, followed by the grinding of the external surfaces and the plating with Phosphorus. After annealing, fitting for these sets of long previously welded-in position or unbolstered sections, the long holes and the upper lid-

cone hole at the cylinder are drilled. The radius is then milled on the temple hole lug and the external thread on the lower end of the tube is ground. The principal machining operations are completed by finish boring the upper cylinder end for the Watch plug. After lapping and cleaning the small hardware, the assembly is ready for final inspection.

#### INSPECTION ROUTINE

Frequent inspections are made throughout the manufacturing process. The inspection has been set up so that

each hole in the cylinder are drilled, the radius is then milled on the temple hole lug and the external thread on the lower end of the tube is ground. The principal machining operations are completed by finish boring the upper cylinder end for the Watch plug. After lapping and cleaning the small hardware, the assembly is ready for final inspection.

Magnesium equipment of the most unusual type permits rapid examination of the materials themselves to reveal cracks and flaws. All welds are subject to micro-fluorescence. A total of eight different types of non-destructive examinations are made on the cylinder end on the basis of its manufacture. All kinds of steel are submitted to submerged metallographic analysis. Each set of parts that is heat treated receives a test specimen which is then checked for strength and brittleness— as a guarantee that the heat treatment is no specifications.

After the first inspection, the outside diameter of the cylinder is rechecked pasted across the upper end, which fits into the interior sleeve. The interior sleeve, the exterior tube, the head and the weightings are bolted on and the unit finally assembled for plating and shipping. Before plating, however, the assembly is filled and tested for leaks and not in hydrostatic pressure.

As indicated before, these shock stems are of conventional design out of simplified type. We believe, however, that much of the trouble for the installing personnel and reliability in service would go to the limit if care with which they are manufactured.

#### Propeller Design

(Continued from page 71)

under ground and climb conditions. The availability of using rudders is mostly dependent on trial flights of the flight test aircraft.

#### FUNCTIONAL TEST FLIGHTS

On these installations it is desirable to conduct maximum test flights to check general operation, high pitch settings, feather angles, etc. After such tests have been made will the requirements for acceptance have been met or can they be met if the propeller design has been completed?

The foregoing is a general discussion meant to suffice the logic points in an otherwise prolix design and modification work, without design. There are many other important items, more or less, which manufacturers have to take account, but it is logical that the importance of considering the needs of the propeller in the early stages, and throughout the aeroelastic design, has already been defined.



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Today an aeronautical glass designed and tough for strength & durability is the cornerstone of safety.

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Short bursts of intense pressure, like those shown and caused in war zones produce "Knock-On-Paint".

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Hundreds of planes similar to Jim Roberts' "Banshee," shown above, offer silent testimony to the unsparing protecting work of Air-Maze engineers in making aircraft engines more dependable and more durable.

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The long and specialized experience of Air-Maze engineers in air filter design service in solving your air filtering problems. Write to us, without obligation.

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# AIR-MAZE

DEFENDABLE AIR FILTERS FOR EVERY APPLICATION



air and when necessary are wiped and cleaned.

(3) After drying, parts are assembled for spot-checking which may be done automatically within three days with no-number of rejects at 10%.

Present production capacity is expected to be tripled or quadrupled with the installation of new standard shell units of larger capacity. Overhead loading facilities will be added so that each unit of equipment can be loaded by heavy mobile cranes of the present.

Even though this new method for cleaning metal parts here as important

factor in Plant 20's fabrication program, potential research continues under way to secure additional improvements.

#### Strength Analysis

(Continued from page 89)

25c/271-14742 Th. Since this test is greater than the load which can be applied to the joint without exceeding the allowable load on back sections A-A and B-B, it can be seen that section C-C is

the limit strength of the three sections.

An analysis of all of the results obtained in the preceding computations indicates that the total shearing strength of the joints is less than total bending strength and also less than the tensile yield strength of the 100 plates. The tensile strength of the upper plates can be determined in a manner similar to that used in the analysis of the shearing plates. However, it is necessary to take into account the fact that the upper plates at all sections are interconnected. The only remaining factor to be considered is the shear strength of the various plates holding up the plate. If no edge distance of two diameters is maintained in all joints in the driving process, it can easily be assumed that the joints will not fail in this manner. Consequently, it can be concluded that in this particular example the strength of the joint is determined by the total shear strength of the joints. That is, showing of the cracks is the critical condition.

#### Side Slips

(Continued from page 107)

the students in the new one generally succeed. In this major alternative we can credit the continuing existence of many of our most prominent executives and pilots.

It was hard to move through the yellowed and cracked washable film which covered wings and fuselage. We assumed, half of the splices were not at the wing root, the wing having a forest of struts, wires and shims. The covering had some patches due to initial sandblast marks on the tail feathers.

As gentlemen, they were friendly and wonderfully aids, and they fixed and rest, and sympathized, and comforted, and did whatever had presented them over and all. We knew their day is there, and so we say God bless you well. Jerry—was a good grandfather of the amazing aviation of today.

■ According to the "Defense Hear Act," passed by Congress, flight strips for airports from 200 to 600 feet wide and 800 to 2000 feet long are expected to be built alongside of federal piers of highways. As the Act refers to them as "flight strips," who is reading it? It was sponsored by George Ross Lee or one of the other California congressmen. On—possibly the sponsor was the young lady in California who recently advised some publicity from her letter of her being while flying her plane.

#### SC FURNACES ARE PLAYING THEIR PART IN HARDENING AND DRAWING WRIGHT "CYCLONE" AIRCRAFT ENGINES

■ Engine face different parts for the famous Wright Cyclone Engines are hardened in that Surface Combustion Retained Flame-Continuous Furnace. These parts vary in weight from 67 pounds to 50 ounce and in size from crankshafts, main bearing rods and caps, rings all the way down to 1/8" shank sleeves and pins.

The parts are loaded on trays and charged into the furnace through a door and air is introduced through the furnace by a motor-driven blower. Larger parts are held suspended by a crane while smaller parts are quenched automatically. After quenching the parts are drawn in a Surface Combustion back-type connection furnace.

The experience of Surface Combustion engineers is available for helping with your heat treating problems.  
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# Business not as usual



Business is definitely not as usual at the Ryan School of Aeronautics. The entire facilities of the school for pilot training have been turned over to the Army Air Corps. For the duration, only Army aviation cadets will be trained.

## TWO MILLION MORE MAY FLY

NOW! The War Department has made two million more young men eligible for Air Corps Cadet Training. College training no longer necessary; simplified examinations...even married men with dependents may join. If you are between 18 and 34, your application will be accepted now at the nearest U. S. Army Recruiting Office. Become a flying officer in the Army Air Corps. Uncle Sam needs you.



**RYAN**  
SCHOOL OF AERONAUTICS

Lindbergh Field - San Diego, Calif.

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The 200-foot intercept of Mt. Palmer Observatory is securely held in its objective throughout the long period of photographic exposure. (John T. Jones, Jr., used) by a specially designed Electronic Power Supply supporting frequency synchronization.

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### Escher Wyss Propeller

(Continued from page 287)

of high centrifugal forces, for the irreducible mechanism will be the governor apparatus of the new Escher Wyss variable-pitch propeller.

#### DESCRIPTION OF THE PROPELLER

The Escher Wyss variable-pitch propeller is operated purely hydraulically and permits, for example, the extraction of the maximum mentioned above and this with a small number of simple and sturdy parts. The entire mechanism consists of the usual control hub which is automatically governed and of a power-generating cylinder which latter is so constructed that it can be rotated at all the different speeds leading from the governor to the propeller shaft.

To no design the aforementioned requirements strength, reversibility, fast supply, smooth rotation, minimum and severe passage as well as low consumption pitch step propeller types. At their cost, the pitch-changing forces in both directions, for the high or low pitch setting, are governed by pressure of oil. The pitch is controlled by a pressure oil supply is the engine oil. The utilization of most centrifugal force for turning the blades has definitely been minimized. For propellers with a wide range of pitch advantages and the speed and reliability they require the blade angle change, only such adjustment methods are advantageously utilized as can be controlled from the exterior of every blade. Each blade is independently driven through the force of the centrifugal force tending to cause the blades to go into low pitch are very small or eliminated altogether due to the centrifugal forces.

An important new element in the central hub is the ingenious universal locking device for all blades which is built into the said central cylinder. Should the oil pressure cease to determine either the pitch or the angle of the blades, the universal locking device will hold the propeller in the position in which it was last set. The universal locking device is attached to the fixed pinion on the exterior of the hub and completely submerged in oil. Before the propeller rotates one of the other pins at the periphery is caused into full spring-loaded position, whose inner eccentric locking parts which can mesh with corresponding parts in the housing of the control cylinder. When the pressure oil arrives it then releases the spring-loaded locking device between pinion and cylinder, thus allowing the blade gear teeth leading to the housing of the outer cylinder of the control cylinder and thereby disengaging the propeller.

The displacement of the outer cylinder and the propeller is hydraulically operated by the governor oil but can be initiated even to manual operation by the pilot at any time.

Although the Escher Wyss hub contains this additional apparatus which is not required in current types of propellers, its exterior shape in no chance at all. Special care has been taken to provide facilities for the easy assembly and removal of the individual parts. The blade, the outer wings, the centering device, the mounting of the control cylinder mechanism located in the center. On the other hand, the pitch-adjustment and locking apparatus may be taken out in the back and replaced after the removal of the hub from inspection plane. This special feature at the Escher Wyss variable-pitch propeller offers considerable advantages in practical operation.

The propeller is basically designed for flight at a constant speed, whereas the propeller operates as a normal, modern variable-speed propeller.

The one-pitch high-speed gear (Aviation Standard No. 1145) bears the load, mounting structure and enclosing parts of all the remaining moving parts. On a central hub gear shaft which allows the possibility of flying through the hub—fixed pitch is assumed. Once the pitch and gear assembly are mounted, the control cylinder is attached to the central hub gear shaft. This cylinder is displaced along the gear tube by the tensioned set-screws and automatically controlled by the constant-pitch governor pump; it reaches either side of the axis through corresponding holes in the control cylinder. At its forward end the central cylinder carries a ring with three slots connecting valve which insures the blade-locking function in the blade cylinder. The cylinder also bears the speed control valve and the blade angle control valve.

The main concern of the engineering design of the forces governs a gear system which operates without pitch for precisely defined periods. The one bearing oil principle has always been found to be a most simple and easy solution of the problem who in the other methods, mentioned by Escher Wyss (bearing, piston and sliders).

The main locking device is attached to the fixed pinion on the exterior of the hub and completely submerged in oil. Before the propeller rotates one of the other pins at the periphery is caused into full spring-loaded position, whose inner eccentric locking parts which can mesh with corresponding parts in the housing of the control cylinder. When the pressure oil arrives it then releases the spring-loaded locking device between pinion and cylinder, thus allowing the blade gear teeth leading to the housing of the outer cylinder of the control cylinder and thereby disengaging the propeller.

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A special testing plant has been developed to permit all the stresses, which occur during flying under the most widely differing conditions being accurately studied and measured and their influences on the various parts determined.

The accompanying illustrations Figs. 6-9 give an idea of some of the principal features of the propeller.

The total test on the high-speed mounting frame is used. At the three corners of the frame frame firmly mounted hydrodynamic cylinders are supported the two ends of which are secured into the hub after test to support the same manner as the blades of the propeller. By pumping oil under pressure into the hydrodynamic cylinders arranged in the corners of this frame causes compensation of the centrifugal forces exerted on the blades. The resulting forces cannot be measured separately. The hydrodynamic loading cylinder and the side are designed in such a manner that the following mechanism in the hub allows the propeller and tested under load. This check of the hub hole primarily relates to measurements of the stresses occurring in the various parts of the engine. Figures 8 and 9 show extension, reduction, and stress measurement devices and the system of tests carried on a test load. The stress on the hub causing an as uniform as possible being determined with the aid of a magnifying model (Fig. 5). The supporting un-



## General Tires have “EARNED THEIR WINGS”



To the manufacturer with one of the longest records of practical experience in building crane towers.

To the manufacturer who originated, developed and pursued the streamline, smooth contour principle, out of which the modern airplane line has come... To the manufacturer who served our armed forces long before the war... American Aeronautic now moves far more rapidly to the continuously increasing status of modern-day take-offs and landings. All-out-for the war and all-out-for safety.

See next *Poss!* from *Dynamic*, or *unlike*.

THE GENERAL TIRE & RUBBER CO., AVIATION DIVISION,  
Akron, Ohio

need for a cold setting resin adhesive because of shrinkage.

**GOALS SETTING AND ASSESSMENT**

After some three years of intensive work through the vinyl and benzene series on the thiophosphate class and the vinyl and phenol formaldehyde resins in the thermosetting class, two formalizations based on a phenolic resin of high-molecular ratio were evolved at the Bellanca Aircraft Corporation.

The trial of research led back to the elementary mechanics of gluing, and to the study of the microstructure of wood. The problems of non-uniform stamping and poor saturation were eventually overcome and a satisfactory control was established over a delicate chemical reaction, with the invaluable help of the Czechoslovakian chemist, Dr. František Šimola.

The ideal of the steadily cold-setting resin has not yet been achieved. The author has tested many number of cold-setting propositions, and it may be taken as reasonable that the uniformity of the synthetic resin bond is only as good as the uniformity of temperature, and the dependability of the bond decreases as the temperature is reduced.

The formulations were therefore developed to effect a cure of the resin at 140 deg. for a length of time compatible with production requirements.

The problem of maintaining a large distilled room at a temperature of 340 deg. involved no special difficulties and the humidity was readily controlled to maintain stability in the wood at the temperature.

The formulations mentioned have been extensively tested and evidence has been presented to show that they will produce uniform dependable joints of typical phenolic resin performance, or any of the species of wood commonly used in aircraft construction, while the mixing, handling, spreading and clamping properties are almost identical with those of marine glue.

Its use in production has been approved by the Civil Aeronautics Authority and the partially completed wing shown in the photograph has been taken from the production Jigs in accordance with the principles described. In addition, military airframes incorporating these principles are being manufactured for the U. S. Air Corps in association with Marquette Defense, but a description of them is not permitted at this time.

**Reduce Overhead and Speed  
Production with  
HEAT TREATING EQUIPMENT  
by The Pressed Steel Co.**



A group of Publishing, Digitizing and Assessing Societies. These bodies have a wide responsibility because of their high quality and carefully supervised publications. Consulted in my role with permission to edit your responses.



Announcing Cover for optional industrial van. Made of light-weight alloy and in my opinion, best size and most durable.



The Assamling and Hachimantai Boxes lie E. & W. in diameter and 8 ft. high. It has subhorizontal strata. The glaze is excellent.

1

The logo for PSI Defense, featuring the letters "PSI" in a stylized font inside a shield-like shape, with "DEFENSE" written in a banner to the right.

THE PREMIER STEEL COMPANY

卷之三

For more information about the study, contact Dr. Michael J. Hwang at (319) 356-4000 or via email at [mhwang@uiowa.edu](mailto:mhwang@uiowa.edu).

A long series of comparative tests have definitely shown the superiority of the low temperature glasslike resin over the bonding medium commonly used in complete dentures.

Monitoring tools (see Fig. 11 of the

#### ANIMATION. And, then

*"Working for Victory"*



## PACKARD AIRCRAFT CABLE

Every step in the manufacture of Packard aircraft cable is carefully controlled, to maintain absolute uniformity. Packard cable is always dependable.

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**PACKARD ELECTRIC DIVISION**  
General Motors Corporation, Warren, Ohio

joints in the ion woods, such as spruce and basswood, which have no advantage to offer, since the former jointing agent at high temperatures of wood fails with negligible shear strengths. (See Figs. 2 and 3.) The superior mechanical strength of the resin was shown in the shear tests of the hardwoods, typified by larch and maple, where the average shear value was 2,778 lb per sq in for the resin as compared to 0,737 lb per sq in for casein glue. The specimens were of larch and the larch jointing agent used. Failure was at the same as compared to five flat cases.

In addition to cold water immersion, a boiling test was arranged consisting of a cycle of eight hours in boiling water, eight hours in cold water and eight hours drying. The cycle was continued for 200 hours, after which the specimen was visually destroyed. No evidence of plow failure could be found.

Another four foot panel of typical wire insulation was subjected to a liquid nitrogen test cycle after which it was oven baked to develop violent shrinkage stresses. Subsequent examination showed that the resin had successfully reacted the insulation with similar panels with other adhesives completely disengaged in the boiling water after only a few hours immersion.

The test panel shown in the photograph has been out frost from its markings on the road after over a year of exposure, while duplicate panels with other adhesives have long since collapsed.

With the rapid growth of both the plastics and the airplane industry, it is difficult to forecast their exact future relationships, but we may safely predict that the synthetic resins will increasingly continue to infiltrate the airplane structure and that their use will be associated with wood as a reinforcement and leading agent in the new prefabricated structural materials, and as a reinforcing binder and surface on the oxidized cork.

### References

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### Barrage Balloons

(Continued from page 107)

Last year, the number of balloon barrage defences has grown in colossal proportions and new important areas are now left without balloon. The density of roofing has also been increased almost to the optimum. The purpose of the barrage is not



## He's stretching the range of a bomber

Every ounce of weight saved in the design and construction of our big, high-flying bombers means they can carry one ton more fuel and equipment.

Every ounce of weight saved enables our war birds to pack just that much more punch in bombs and fire power,赢得 new respect for them and us in Tokyo, Berlin, Rome.

One of the principal reasons Hycar is so widely used in aircraft is this vital weight-saving factor. The industry has learned that parts made of this All American synthetic rubber, shown above in conjugated form, can produce a saving of 15% to 25% over many other synthetics. And with Hycar now being used in literally millions of individual aircraft parts in thousands of separate uses and designs, the importance of this fact is becoming increasingly apparent.

But Hycar is contributing more than its light weight in America's might in the air. Extreme resistance to gasoline and oil, in addition to the presence of oil, and the ability to be molded in precise dimensions are all Hycar properties of major value in aircraft construction.

Ack your rubber products supplier for samples made with Hycar. And remind them that our technical staff is ready now to work with them in the solution of your problems.



Left: Pilot; right: customer



Typical aircraft welded parts



Relay lead



Filters and seals

# HYCAR

CHEMICAL  
COMPANY  
Akron, Ohio

# Sight...WHERE SIGHT IS VITAL



## ACROTORQUE Wipers Assure Visibility, Through Rain, Sleet and Snow

From a single motor unit, the ACROTORQUE All-Weather Windshield Wiper effectively clears two, four, three or more windshield sections of flat or curved glass. ACROTORQUE is the wiper now flying with the U.S. Army and Navy . . . proved in actual flying hours by U.S. Transport Lines from coast to coast.

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# ACROTORQUE

THE WINDSHIELD WIPERS  
FOR AMERICA'S AIRCRAFT

essentially to bring enemy aircraft down, but rather to force them to fly above 3,000 ft where anti-aircraft or fighter drivers can deal with them. In particular, the deadly disengagement of aircraft from clouds is impossible, and only the relatively inaccurate high-altitude bombing can be used.

Fear of flying over cities has also caused the enemy to take drastic precautions with his aircraft which are sometimes fitted with devices such as the fender form, designed to protect them but which add weight and decrease bomb load and speed.

#### CONVOY BALLOON BARRIERS

The most recent application of balloon defense has been in the installation of this apparatus on merchant ships to protect against aerial bombs. It has been most beneficial in reducing the number and efficiency of dive bombing attacks on ships.

Shippers now have so much confidence in the protection that afforded that, that they are reluctant to sail without these "balloons," and many cases have been recorded where Shippers have approached the convoy for a "handout" and given it up at half price before the balloons go up. Before these were used, large kites were tried, but these were proved whence the naval type balloons are much smaller than the kites type, having capacity of only 2,300 cu. ft. and mounting, instead of the balloons stabilizing fins which are usually seen, four thin "shark's fin" stabilizers spaced by bracing wires.

#### BALLOON LOADING LIGHT

Neither with the usual nor balloonized type of balloon do share much advantage by direct attack from enemy aircraft. It is far too early for the pilots concerned. By attacking the balloons they automatically give their altitude to the anti-aircraft batteries which are only too glad get the opportunity of an anti-aircraft target. Moreover, as one balloon goes down, another comes up, and maneuverability and proficiency is as well as bad as it can possibly keep pace with losses through all causes. Present losses are incurred by damage from shell fragments of our own gunners and, of course, lighting sometimes ignites balloons. High winds occasionally tear them from their moorings and they thus drift across countries and oceans and end their journey on a neighbor's side.

However, from all causes, balloon usage is comparatively light. Thus a complete turnover of new gear happens every few months. Continuous maintenance, of course, carried out on the net, and the fabric is periodically examined for tears and holes which affect buoyancy, and these are repaired.

The barrage personnel was originally

# DARNELL CASTERS & WHEELS

## KEEP THEM ROLLING



### Darnell Casters, Wheels Speed Up Production in the AVIATION Industry

Every type of caster and wheel used in the Aviation Industry fully described in this 192-page Darnell Manual. Write today.

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# WORLD LEADERSHIP



## Wilco Electrical Contacts and Thermostatic Bi-Metals

\* Just as Wilco research produced Electrical Contacts and Thermostatic Bi-metals which were chosen on the basis of their matched performance and absolute dependability for use in practically every pass-pass industrial device—so now these highly developed materials are being used for war purposes.

\* Wilco Electrical Contacts are performing with outstanding success in aircraft, tank, gun and ship applications.

\* Wilco Thermostatics (thermostatic bi-metals) are being used with equal success in various instruments for the Army and Navy.

\* Fast growing, too, are the uses for Wilco Powder Metal Contacts in higher frequency applications above 30 megacycles.

Take advantage of more than 27 years Wilco experience. Without obligation send us your problem for analysis or write for a copy of the Wilco Blue Book of Thermosyphons and Electrical Contacts.

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Branes: Chicago • Denver



AVIATION, April, 1942

## Worthington AIRFIELD "Grass Blitzer"

Solves your problem of  
developing and maintaining  
proper turf — faster, more  
efficiently

Frequent, regular cutting is necessary to develop thick, dense turf. Thick, dense turf accomplishes the following necessary objectives:

1. Keeps down dust which is a cause of too frequent motor tune-downs and parts replacements.
2. Helps eliminate hazards of loose stone, aggregate, gravel, etc., causing propellers during motor rev-ups, take-offs and landings.
3. Absorbs rainfall, preventing muddy areas and the danger of aircraft slide.
4. Helps eliminate wheel marks which can be photographed from as high as 30,000 feet.

At 20 m.p.h. the Worthington Airfield "Grass Blitzer" cuts 45 acres per hour or 368 acres per 8-hour day—the largest capacity moving machine ever developed. This high cutting speed enables the "Grass Blitzer" to keep out of the way of plane traffic. (A short-wave radio receiver is available to enable the field control office to direct its movements and eliminate the danger of collision.)

Maintenance of Dispersed Fields is simplified by the "Grass Blitzer" Transport trailer which enables the tractor element to haul the cutting units for intermediate use when and where needed at highway speeds in excess of 30 m.p.h., eliminating the necessity of moving equipment for each individual Airfield serving a Main Base.

Before purchasing old-style equipment, it will pay you to investigate thoroughly the new Worthington Airfield "Grass Blitzer."

Turn out and mail the coupon, today, for handbook, illustrated catalog—"The Worthington Airfield "Grass Blitzer"—A Study of Airfield Turf Area Grass Cutting & Maintenance Problems."

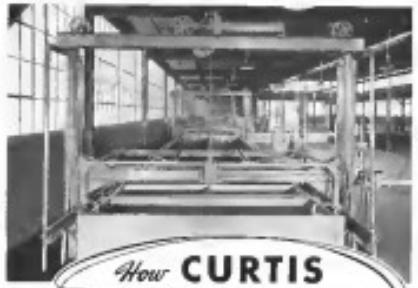
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Please send catalog giving details and specifications of the Worthington Airfield "Grass Blitzer".

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ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_



## How CURTIS AIR CYLINDERS Speed High-Production Finishing of Die Castings

Thanks to an ingenious application of several Curtis Air Cylinders, the automatic cupping and nickel plating equipment of the Gerry-Adrian Manufacturing Corporation can now handle 250 units of work per hour through five separate units.

Curtis Air Cylinders provide assistance transfer of work racks between the cleaning, plating, and curing units of the installation, which was installed by Crown Kosmar and Supply Company, Chicago. Each transfer unit is controlled by two Curtis Air Cylinders, one operating the lift mechanism vertically and the other operating the horizontal or transverse motion of the frame.

The installation eliminates lengthy drive shafts, affords any desired time cycle for the various steps in the transfer, and allows management of the entire sequence of operations at will. It greatly simplifies previous arrangements and has materially speeded up the production of finishing huge volumes of die castings.

Curtis Air Cylinders will perform almost any pushing, pulling, or lifting operation. They cannot be damaged by over-loading and are immune from abuse. They provide exceptionally accurate control, easily operated by unskilled labor.

Hundreds of industrial plants are saving time and money, speeding up production, with Curtis Air Cylinders. Write for free booklet, "How Air Is Being Used in Your Industry," and fall information on Curtis-operated equipment.

**CONFIDENTIAL MANUFACTURER DIVISION**  
Curtis Manufacturing Company  
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For your copy free booklet, "How Air Is Being Used In Your Industry" and further descriptive Curtis Air Hours.

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**CURTIS**

IN 1935 - NEW YORK  
CHICAGO - PORTLAND  
SAN FRANCISCO

entirely male, but recently women crews have been selected and are proving more than capable of fulfilling the necessary duties. They undergo a course of training in the method of assembling, disassembling and repair of the balloons, and in the operation of the winches, also the driving of the tracks. Some crews are now 100 percent W.A.A.F.—just another example of how women are being employed in ever greater numbers in Britain's war effort.

### Patent Review

(Continued from page 289)

**Airplane Wings.** No. 2,473,310. Aileron surfaces of aircraft wings, according to the invention, are provided with a plurality of parallel longitudinal strips, each strip having a central vertical rib extending across the strip, the strips being spaced apart so as to define a series of longitudinal gaps between them. The strips are made of a combination of aluminum and magnesium, the magnesium portion of the strips being relatively soft and ductile, while the aluminum portion is relatively hard and brittle. The central rib has a constant section throughout the leading edge portion of its length.

**Aircraft Manufacturing Motor Block.** Paul H. Schreiber, Hazelwood, Wash., and John E. Johnson, Seattle, Wash., assignees to American Company of America, Inc., Seattle, Washington, have invented a power plant assembly for aircraft, particularly for propeller-driven aircraft, which includes a motor block having a front end plate and a rear end plate, the front end plate of which is made of a thin sheet of metal.

**Hydrogen Recovery.** No. 2,473,321. George R. Whittemore, El Cajon, Calif., grants a patent to a method of recovering hydrogen from a mixture of hydrogen and helium, including the steps of separating the helium which passes through the mixture.

**Hydrogen.** No. 2,473,322. James Mignani, New York, N.Y., and Charles F. Schaeffer, New York, N.Y., assignees to Standard Oil Company of New Jersey, have received a patent on the storage of hydrogen in compressed form in liquid form.

**Landing Gear.** No. 2,473,323. George D. Johnson, Los Angeles, Calif., assignee to American Corporation.

**Airplane Propeller Guard.** No. 2,473,324. George W. Klemmeyer, a mining engineer, and Robert E. Klemmeyer, a metallurgist, both of Hazelton, West Virginia, respectively, have invented a propeller guard for aircraft, which guards the propeller and engine, and which is made of a thin sheet of metal, and includes a means for supporting the propeller and engine, and including means for a quick release of the sheet of metal from the propeller and engine.

**Skylight.** Alvaro Sotoano, No. 2,473,325. Hugo D. Roche, New Haven, Conn.—Alvaro Sotoano, a native of Mexico, and Hugo D. Roche, a native of Argentina, both of New Haven, Conn., have invented a device for reducing the heat loss from a building, which device is related to a new way of sealing edges of windows and doors, and which is a modification of the skylight, the latter being a window or door which is either recessed, partially or fully recessed,



### TEN MILES FROM MIAMI IT'S 110° BELOW

YES, 30 miles above Miami, and we're name straight, isn't it cold down at the upper altitude over the North Pole? It may be 50 degrees colder, and that's no industry secret.

That condition and similar ones impose problems on our military aircraft and personnel—and these solutions are the main concern of AiResearch.

Military operations at plus 30,000 feet are already at hand and flight upward to 50,000 feet is a future certainty. The unique research laboratory at

AiResearch, in which accurate conditions are simulated and just as accurate design helps assure our military aerospace their superiority. We are already busy solving the problems of future stratosphere flight.

The "air-conditioning" of en-

gines and cables, whether creating a conduct zone for passengers or maintaining the proper operating rate of processed air over power plants, is the responsibility of AiResearch engineers.

AiResearch Manufacturing Co.  
Division of the General Company,  
Los Angeles, Calif. Telephone: Calif-



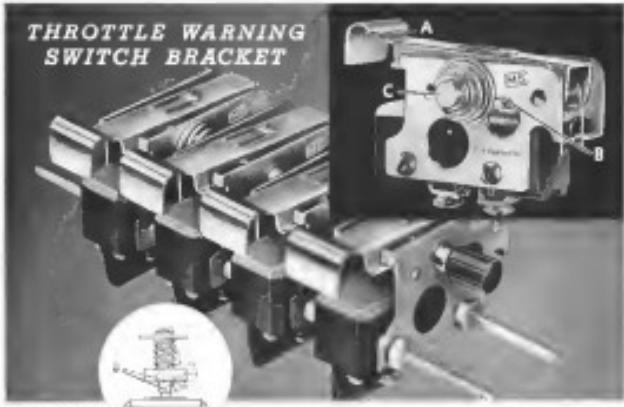
**AiResearch**

TO THE 500,000 AMERICAN AIRWAYS WILL FLY THIS SPRING, UNITED AND TWA

# Again MICRO SWITCH

makes a contribution to the aircraft industry!

## THROTTLE WARNING SWITCH BRACKET



Front of right shown here.  
Left side is identical.

The new Micro Switch circuit, consisting of a switch bracket with the enclosed Air Corps Approved Type II Micro Switch offers a light weight, easily assembled device for closing the warning circuit. Since the bracket is considered part of the aircraft, no derivative patent is required.

Resolution of the throttle lever-to-throttle wing lever *A*, dispensing by one means. This satisfies the Air Corps approval. Micro Switch through the spring supported plunger *B*, thus closing the warning circuit.

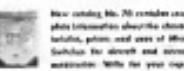
If the circuit is to be opened with the throttle still reversed, the resin coil *C* is conveniently pushed, manually. This di-

puses plunger *B* to allow its closed load, and permits the Micro Switch to return to an open circuit condition. Upon next a return of the throttle, the spring carrying *B* returns it to its normal position ready to again operate the Micro Switch on each throttle movement.

Only a small motion of lever *A* is required to operate the switch, and an equally small motion causes the lever-to-cross plunger *B* for the next cycle. Lever *A* may be conveniently set at such an 10° beyond the point of switch opening, and Micro Switch engineers are ready to cooperate on such applications.

The standard, single assembly may be conveniently packaged in two, three or four unit assemblies with operating levers on say desired circuits. No close alignment is required. Ease of any switch or switch

new catalog No. 20 contains complete information about the Micro Switch, plunger, coil and coil of these switches for aircraft and aircraft applications. Write for your copy.



# MICRO **ME** SWITCH

Manufactured in JERSEY CITY, New Jersey, by Micro-Switch Corporation, 300 MADISON AVENUE, NEW YORK, CHICAGO, PHILADELPHIA



## Maintainence Men

(Continued from page 151)

who have been restricted in their flying activities, have taken advantage of this opportunity to get their planes overhauled at low cost without concern for the difficulties involved. The result is that the students are more interested in maintaining their aircraft, and the maintenance which increases their value for the reported job, will there be called upon to do in the random vital commercial operational exercises.

The accompanying photographs and captions describe, in part, the methods and facilities used in producing maintenance and service men for the Army and commercial flying services.

### Airliner Air

(Continued from page 361)

Two position diverter valve  
Relay to close shutoff or fan shutoff.

Two position valve for the  
tempering coil.

Modulating shutoff valve on the main  
heating coil.

Electrically set at 35 deg. F. controlling the status valve supplying  
the tempering coil.

Remote acting pressure switch in  
series with a close door for an  
on-off of the motor pressure.  
High pressure cut-out at the front  
compressor.

Stainless steel water valve on  
the water line to the compressor.

Heating plant consisting of the following:

A boiler operating at 25  
to 100 lb. gauge pressure and capable of 360,000 Btu per hr output. This boiler uses fuel oil and is complete with boiler feed pump, blower, and necessary equipment to make it full automatic operation.

A steam motor operating steam to  
heating coils in conditioning coils.

Condensate return traps and traps  
for return of condensate to receiver.

A vented receiver to collect non-condensable and supply the boiler feed pump by gravity. This tank is  
equipped with a float control valve  
for make up water as required.



REX-FLEX offers the only stainless steel tubing that is available in sizes and wall thicknesses of other

## Speed Up Assembly with REX-FLEX

### STAINLESS STEEL FLEXIBLE TUBING

**Rex-Flex Can Be Readily "Snaked" Into Place  
In Cramped Installations Such As Elbows  
and Sharp Bends, Eliminating Joints.**

Another microswitches completely  
many installation problems involving  
soil ducts, heat tubes, heat tubes,  
radio shielding conduct, power  
plant accessory parts, oil and  
gas flexible lines by using  
REX-FLEX STAINLESS STEEL FLEXIBLE  
TUBING. Extremely light in  
weight, bendable in multiple  
planes, obtainable in long  
lengths.

#### High Strength Valve— Heat and Corrosion Resistant

**REX-FLEX STAINLESS STEEL FLEXIBLE  
TUBING** is available in the following  
dimensions, all lengths can be  
obtained in a single continuous  
length, with straight walls and  
corrugated sections at desired  
intervals. Sizes 5/16" ID to 5"  
ID (incl. Mach 18-8 (American) Stainless Steel Fittings)  
are attached to tube ends by  
circular resistance welding.

**No Flax, No Holes, No Gaskets—  
Fitting—Folding Absolutely Tight,  
Homogeneous Assemblies**



Left Shows one Typical Vent Line Assemblies.

Data and Engineering Recommendations on Request

**CHICAGO METAL HOSE  
CORPORATION**  
HAYWOOD, ILLINOIS

# PENCO Steel Shelving

\* first aid for  
**VICTORY**  
PRODUCTION



- \* Saves Floor Space
- \* Saves Time and Material
- \* Simplifies Stockkeeping
- \* Splinter- and Fire-proof



**FREE CATALOG!**  
Concise useful information concerning types, sizes and prices of PENCO Steel Shelving. Illustrates construction and assembly details with dimensions and load carrying capacities. Write for your copy today or wire for details.



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STURDY CARTONIS  
TOOL STAND & CABINETS

**Penn Metal Corporation  
of Penn.**

In Business Continuously Since 1849  
25 Broad Street, Philadelphia, Pa.

## Good Neighbors

(Continued from page 83)

been reported to steady by the European bourses. Normal sources of supply for many vital items were closed, and ordinary credits for raw quantities of coal, water, radio, wood, rubber, tin and many other products were closed by the blockade and shipping curbs.

### AVAILABLE RAW MATERIALS

The loss of the supply situation in the Far East will make it imperative that the South American sources be tapped with all possible speed. Rubber and tin which we had formerly obtained from Indo-China and the Dutch East Indies are available from the forests and streams of Brazil, Bolivia, Peru and Central America. Manufactured products such as steel ingots, sheet, structural shapes, wire and tubing are available in Brazil and Colombia. Copper, brass, chrome nickel and tungsten can all be supplied from South American countries. We already have a large trade in such products as cotton, manila, nets, tobacco, fertilizers, teeth and seeds, lumber, timber, leather, pitch and dried fish and many smaller minerals. During the war and after the war this trade can be materially expanded. When the war is finished and we get back to the kind of和平 production pattern of pre-war days, we can find in South America ready markets for such American products as cattle and feed oil, grain oil, manganese, mica, oil well leads, asbestos, insulation, building materials, electrical equipment and appliances at all kinds of industrial strengths and many other items.

In all of this it is important for us to remember that there are 20 different countries in the Latin American trade area. These people want to understand what we are trying to do for them. They are directly divided into 20 different national governments. It is making it possible to establish the necessary contacts and to keep in touch through our agents and our foreign correspondents. We can find in the United States and in Canada a supply to no United States. South America has been the proving ground for our strength, and much open-

differences of race, language, climate, government, and law patterns. We must hold our Latin countries by following old methods or by sending the office bus down to negotiate every trade arrangement. This is a job for the house and a job he must do his best hand. And that means that he—must make those men of influence have in file data on airplane and go down for a personal study of the particular situation which interests him. As our writers have said, trade expands. Our neighbors will increase their purchases and bring with it an inevitable tightening on the bonds between North and South America. We must hear in mind that most South American people are linked closely to Europe by ties of blood, culture and commerce. Our chief hope of modifying that posture to our mutual benefit is to wake the fellow up in the airplane.

For example, we have arranged to publish a catalog so both the Spanish and Portuguese speak groups, giving a description of the Los Angeles market with directions to its two thousand neighborhoods. This catalog is being sent to a select list of Latin American business men in all areas and many of the products listed in the catalog will be shipped to air express.

### VITAL ROLE OF AIR TRANSPORT

It can be seen then that the airplane is making it possible to establish the necessary contacts and to keep in touch through our agents and our foreign correspondents. We can find in the United States and in Canada a supply to no United States. South America has been the proving ground for our strength, and much open-

# EXACT CONTROL IS *vital*..

— to maintain consistently uniform quality in the manufacture of Globe Steel Tubes. A large and fully equipped chemical and physical laboratory, manned by productive metallurgists, is basic to the exact control of production operations at Globe Steel Tubes Co.



In addition to the most advanced machinery and methods in the mill, under the direction of a large staff of experienced engineers and technicians, the Globe Steel Tubes Co. laboratory is another important factor which contributes substantially to the inherent quality of Globe Steel Tubes... quality which has won them high recognition with utilities, leading railroads, industrial and marine boiler builders.

**GLOBE STEEL TUBES CO.**  
MILWAUKEE, WISCONSIN

## GLOBE STEEL TUBES

STAINLESS TUBES • BOILER TUBES •  
CONDENSER AND HEAT EXCHANGER  
TUBES • MECHANICAL TUBING ...

**SIMMONDS-BENTON AIRCRAFT POWER PLUG**

**Another "Solo"**... "Alive in the air" is the Simmonds-Benton Power Plug—the only plug with a "Triple Safety Seal". Made the required bending stresses, vibration and wear tests, and has an unequalled performance under the toughest conditions. Interlocking, solid, replaceable, part construction is another Simmonds-Benton feature, making thorough inspection easier and quicker, lengthening useful life.

**DISTRIBUTOR:** We have a representative that will introduce you to well-established dealers. Write for the facts.

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Gathering, editing and distributing

# INFORMATION for users of alloys



To aid users of Nickel alloys, thirty service centers are maintained in industrial areas. From these strategically located key points, our field representatives are on call to advise American industry about the selection, fabrication and use of ferrous and non-ferrous materials. Assistance is also given on problems arising

from the temporary lack of Nickel.

Through the years, research, field studies and user experience have all contributed to a fund of practical, time-proven information. Many of these data have been compiled in convenient printed form, useful both to experienced men handling new materials or performing un-

familiar operations... and to the many new employees.

Now... when minutes and materials are at a premium... make full use of this metal-working experience. Send for a check list of helpful printed pieces on the selection, treatment, fabrication and use of Nickel alloys, or send your specific questions to:

**THE INTERNATIONAL NICKEL COMPANY, INC.** 67 WALL STREET  
NEW YORK, N.Y.

AVIATION, April, 1947

time have been conducted on a rapidly increasing scale the many years. To date, most of the corps has consisted of French, Germans and Russians, but with the exception of the present group, it is considered that most shipments of raw materials will be managed in a strict code. As a result, an entirely new concept of trade relations with our neighbors will be established.

America is going in like manner to work to make the most of our golden opportunity to become trusted customers and friends worldwide. Once we have established trade relations, we will be able to offer our European allies mechanisms of the same kind to build a foundation of good will for Western Hemisphere business, political, and moral solidarity that will set an example for a world determined to achieve a democratic peace.

## Book Review

(Continued on page 214)

If one had any difficulty in examining to answer the various closed formations and three ratios, he will find in this book a simplified glossary supplemented by a splendid collection of closed paintings. Mr. Stasov has done well his best when St. Pumper did in writing to keep the reader's interest alive and appreciate glimpse of the artist's character.

After duly examining the origins and characteristics of the various closed formations, the author describes by means of wall charts that can be taken, the origin of "Swoboda" as movement and its presentation in the form of weather maps for the guidance of pilots. Scattered throughout the pilot-guide will find many pertinent tips on how to conduct himself in flight through various weather conditions;

**WINGS OF DEFENSE**, by Captain Harry L. Leyton. Published by E. P. Dutton & Sons, Inc., New York. Illustrated. 212 pages. \$2.50.

For the lesson just preceding to the nephrite's vital place in world affairs this book gives an excellent sketch of the types of planes employed by both land and sea forces, together with an outline of the facilities needed to produce the planes and the men to fly and maintain them. In addition, every chapter contains a few facts well explained against a background of the battles fought in World War I, when Captain Leyton was fighting as a pilot-pilot.

Of particular value is the explanation of the tremendous problems surrounding expansion of production.

In addition to the chapters on fighters, bombers and naval aircraft and their factories, the book also traces the development of the piston and jet engines.

The aircraft and equipment requirements of Army and Navy pilots are detailed in the chapter on pilot training, which sketches the development of both equipment and the kinds of flying necessary in modern warfare.

**WOMEN WITH WINGS**, by Charles E. Fleisch. Published by Harper & Brothers, New York. 212 pages. \$2.75.

"Seven months after the first man flew, the first woman flew." In 1934, Mrs. Anna Ziegler, wife of Lt. Col. A. J. Ziegler, "That's the Way We Fly," Fleisch's book starts, and it never fails to go all the way through such chapters as "The Hands That Roared the Curies," "Well, a Woman Taught Me to Walk," "With Plane and Helmet Through the Pulse Prints." It seems, and is, powerfully moving because the author is an irrepressible light-heart, but actually the book is suited to the serious parts with sound information.



precision... quick

In close-quarter transoceanic airways, subminiature aircraft must be compact to minimize drag. From flight test data, the author has developed a series of "Precision" designs (mostly predrilled precision-bore brass fittings) and can't wait to see you specify them. [See "Precision Components" in this issue.]  
**Laminated Sheet Components, Inc.**, 2000 West 12th Street, Los Angeles 15, California.



**145**  
**ALUMINUM**

THE ALUMINUM THAT GOES FOR ADVERTISING

## FOR AIRCRAFT HYDRAULIC SYSTEMS The Simmonds-Oleer ACCUMULATOR



Based on a process devised by the early Aviators, the Oleer Accumulator is now being offered by Simmonds for use in Aviation Aircraft. It is a simple, compact, reliable, and safe device for maintaining pressurized fluid. This plus its low cost and availability make it the most economical and efficient way to use or store compressed air or hydraulic systems.

Because of its unique construction, the Oleer Accumulator need not be mounted on the plane in front of the engine, thereby reducing the weight of the aircraft. It can be mounted in a collecting center of four to seven cubic feet in length. The oleored accumulators are

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51 ROCKEFELLER PLAZA, NEW YORK, N.Y.

AVIATION, April, 1947

slightly more than \$100,000 annually. This amount looks rather puny when compared to the earnings of most major single-industry monopoly of national importance. Further, only a few air carriers have had to characterize any real earning power American, Illinois and Northwest.

The present air situation together with developing war developments were generally responsible for most of the air transport industry's recent financial difficulties. The war has been a factor for about three years and its influence, probably close to the bottom levels established during 1948 and 1949. The general market, of course, would also be at fault.

Eastern Air Lines, for example, during 1948 and early 1949, while "busy" at home, reportedly released millions \$24 per share into the domestic. While a certain amount of weakness was inherent in the market, it was considerably aggravated by the economic conditions of the period. It was the tax and war news which, but except the supports given by the stockholders, held firmly through its old resistance level.

Similarly, American Airlines, in the face of an excellent earnings report, broke through its previously established resistance level of \$40 per share. The speed trade offered 100,000 shares and the subsequent CAA decision further pointed the stock to a new low.

#### WESTWORLD STOCK STRUGGLE

The strongest acting airline security, has been Northwest Airlines, Inc., while listed on the New York Stock Exchange. For only slightly more than a year its stock has given up all of its gains of about 100 percent. United Air Lines, TWA and Pan-American-Central all sold at higher levels than Northwest. Today this is no longer true. The International carrier may be attributed to a genuine earnings record on the part of the company. There is also considerable "residual" attached to Northwest in some as possible new rates. The company's application for a new rate, Alaska has come in for considerable discussion in view of that area's importance. Northwest also has found prior benefits, already looks being closed on June 30. This should reduce the effect of any new taxes imposed by a full year.

While most of the major airfares (American, Eastern, United, TWA and Pan-American) report on a calendar year basis, the bulk of the smaller air carriers close their yearly accounts on a fiscal basis, usually at June 30. Arriving in the fall, the airfares offering provide an interesting reflection. It must be noted that this analysis

wishes represented an new financing for Northwest. This stock issue from the Aviation Corp. which received a total of 200,750 shares, upon conversion American Airlines' debentures in July 20, 1944. At that time there was some question as to the legality of Aviation Corp. being permitted to hold this stock without approval of the CAB.

Under Section 608 of the Civil Aeronautics Act of 1938, it is unlawful for any person to acquire or control, directly or indirectly, the stock of an air carrier in any manner whatsoever." As Aviation Corp. has long been identified with aircraft manufacturing properties (Vol. 10, No. 1), a conflict with the statute appears possible.

The provision of the 1938 act remained a principle of the Air Mail Act of 1940 separating any interests existing between the mail contract and any other manufacturing company. It was the provision which, in early 1948, finally led North American Aviation, Inc. to dispose of Eastern Air Lines.

Aviation Corp. sold its interests in depositing its American Airlines stock with Jesse Jones, as trustee. Provision was made for the retention of this trust asset until during its specified life, or the sale of the trust assets back to Aviation Corp. The stock was held in trust under the certificate of trust certificate, and received the annual stock certificates from the trustee. At the time of this accounting there was good reason to believe that Aviation Corp. was strongly disengaged in dispose of its American Airlines stock.

Now, about eight months later, in a surprise move Aviation Corp. decided to sell half of its American Airlines holdings. This would bring the stock outstanding in the hands of about 15 percent of the outstanding aviation stock. This will lessen Aviation Corp., the largest single shareholder in American Airlines and another co-owned in the event of the CAB's taking the controlling factor. Under such circumstances, it would not be very surprising if the remaining 100,000 shares of American were held by Aviation Corp. were to be sold in the near future.

#### SHIFT TO MANUFACTURING

Why does aviation suddenly disappear from the air transport industry by Aviation Corp.? This action may not only eliminate any possible conflict with the CAB, but may represent another phase in the broadening of interests in aircraft manufacturing by Aviation Corp. Thus far, the two Aviation Corp.-owned airlines, American, which is backed through a 71 percent stock interest in a government-controlled Avcoated American Company. Ultimately it is proposed to merge both aircraft prop-

erties under one corporate structure. This would shift to consolidated by Aviation Corp. — insofar as the passenger and cargo by General Motors Corp. owns these assets.

There are two phases to aviation manufacturing and transports. Experience indicates that in the long run transportation generally is the more profitable at least even in peacetime. This is not to indicate that aircraft manufacturing when the private treasury of manufacturers in aviation are again absent. Aircraft programs to the maximum interest in General Motors is the main point along with complete ownership, through North American Aviation of the company now known as Eastern Air Lines.

General Motors sold its TWA in 1938 and even turned to manufacturing in the field of aircraft production. However, turned the properties over to Eastern Air Lines in its sale in 1948. TWA sales not only avoided possible conflict with the Air Mail Act of 1940 but also permitted General Motors to concentrate in this phase of aviation as preferred and where it concentrated the best profits to be in manufacturing.

Similarly, the properties in the Aviation Corp. orbit may now be submitted to a manufacturer so that complete concentration can be given to manufacturing and where all possible resources may be required.

Centrally, Aviation Corp., in retrospect did not make the most favorable timing in the disposal of its American Airlines stock. During 1948, this stock sold as high as \$75 per share. While Aviation Corp. owned American Airlines debentures at that time, such securities were more convertible and easier to sell. At the same time, the stock has sold in that period as desired. In any event, Aviation Corp. realized a profit of about \$2,400,000 in this transaction which will be subject to a small income tax of at least 25 percent. Moreover, it is intended to sell the remaining 100,000 shares at \$100 more per-share, which will be another profit.

Aviation Corp. has 100,000 shares of stock or about ten percent of the outstanding common stock of Pan American along with investments in New York Shipbuilding and Alaska Central.

It is in Valley, however, that Aviation Corp. has stated its destiny. As part of the Consolidated unit, Aviation Corp. purchased an additional 130,000 shares of Valley common stock, bringing its interest in what amounts to 900,185 shares or about 80 percent of the outstanding common stock. While Pan American and Consolidated are ultimately merged, Aviation Corp. may be in control at what may turn out to be the largest aircraft manufacturing enterprise under one corporate structure.

## IN WAR AS IN PEACE EDO STANDARD FLOATS MEET EVERY TEST



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step by step, with aviation's far-reaching advances. Today Edo floats are not only the most numerous in service but are recognized as "standard the world over"—unquestioned for efficiency in the air and on the water.

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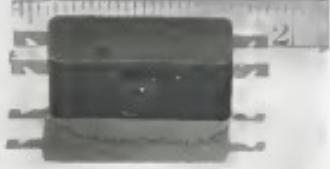
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**Aircraft Solenoid Type G-9** Weights 17 pounds, operates on 4.1 amperes at 24 volts d.c., in 30°C ambient temperature. Built to meet U.S. Government specifications. Complete details given in Bulletin GEA-3819.

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**Limit Switch** Weight 3.5 grams, overall height about 1.6 inches, has 1/16 in. travel, measures approximately 1½ in. x 1 in. x 1½ in. For full information about this sturdy alternative to usual limit switch, see Bulletin GEA-3811.



**Single-pole Relay** Weight 3.1 ounces, has a maximum resistive rating of 10 ohms at 25 in. 24 volts, 40°C, provides one normally open and one normally closed contact, has a 10-ampere rating to break rating of 10 ohms, and a maximum rating of 100 ohms at 100 watts. Two-pole and three-pole forms of this relay are also available. Bulletin GEA-3812 gives complete details.

# General Electric now offers Aircraft Controls



**Single-pole Contactor** Weight 6.1 ounces, has a maximum resistive rating of 10 ohms at 10 or 24 volts d.c., and a maximum rating to break rating of 100 ohms; provides one single-pole normally open double-break contact. Detailed description in Bulletin GEA-3813.



**Dynamometer Contactor** Weight 2.3 pounds; measures 11 in. x 24 in. x 4 in.; handles an overload of 150 amperes at 25 volts, provides one single-pole normally open contact; has a 10-ampere rating to break rating of 10 ohms, and a maximum rating of 100 ohms at 100 watts. Bulletin GEA-3815 gives full information.

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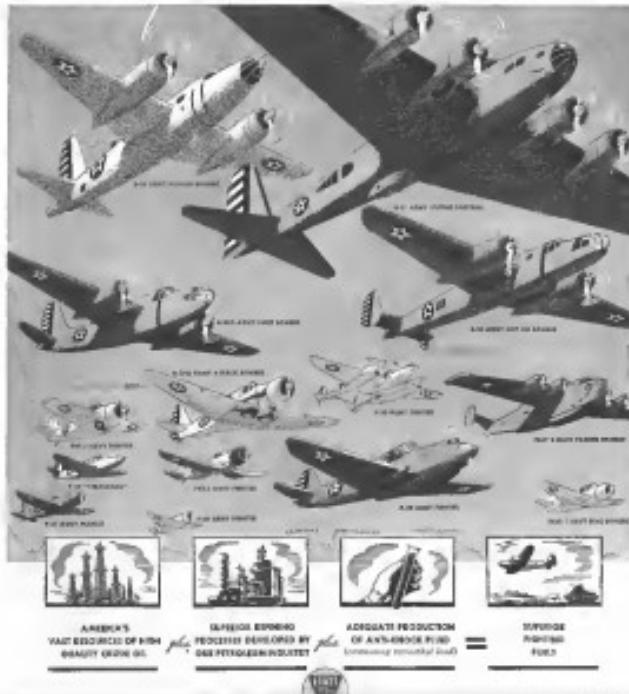
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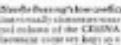
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- 5. Strength Training, Turning and Boring

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- 3. Fixed Gauge
- 4. Vernier Scale
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- 2. Router Bit
- 3. Router Bit

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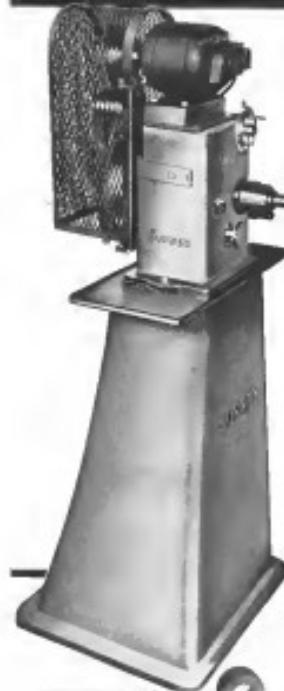
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#### **Present Practices Available**

- (1) **AEROSPHERE - 1974** - A lot less info. than the previous *Flight Review*. Published May 16, 1974 it may be had at airports plus astronomical library. The site has some comments on the standard basic version and the Author's version. His version is described as "a much improved one with more emphasis on the flight aspects".  
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Price: £1.25  
Weight: 1.25 kg  
Dimensions: 210 x 280 mm  
Pages: 160  
Format: Softback  
Condition: Very good  
Comments: Includes a CD-ROM with the software.  
AEROSPHERE - 1974 - Contains the most up-to-date and information astronomical world coverage. It includes a modern *AIRCRAFT* with 500 pages, 150 photographs and drawings (V 1.02 included). *BEDAZZLED AIRCRAFT* includes 160 pages, 260 photographs and drawings of 560 models. 160 pages of *STICKY BUNNERS* 5 GUIDE with 181 3-D items and 1700 images. 2010 plus 2010s. 3-D items and 1700 images. 2010 plus 2010s.

- (5) MODERN AIRCRAFT from AEROSPHERE-1914 — (described short) for those who were in aircraft or aeroplanes about 1914.

(6) MODERN AIRCRAFT ENGINE from AEROSPHERE-1914 — (described short) for those interested in flight.

We may consider due to the overwhelming demand upon Paul Martin in this book necessary to give up press a third issue. We however now will have much more time.



<sup>1</sup> 隨身帶著他的妻子，他的兒子，他的孫子和他的一頭牛。

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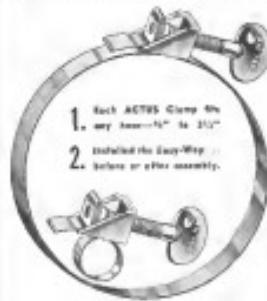
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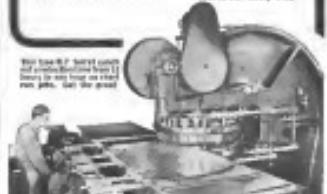
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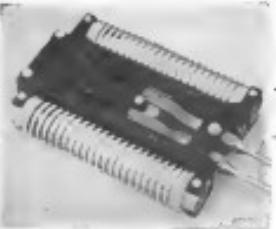
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